THE FAMILY ANEURACEAE IN AUSTRALIA AND NEW GUINEA: II. THE GENUS *RICCARDIA*

H. J. Hewson

*School of Biological Sciences, University of Sydney**

(Plates II–V)

[Accepted for publication 11th February 1970]

Synopsis

Thirty eight species are recognized as occurring in this geographical region. Eighteen of these species are described here for the first time. One of these species has two varieties. Using these thirty-nine taxa Schuster's subgeneric classification is questioned and rejected using a Mixed Data Numerical Analysis. Keys are provided to the species found in each of the two major distribution regions.

Introduction

There are three known and accepted genera in the family Aneuraceae, *Riccardia* S. F. Gray, *Aneura* Dum. and *Cryptothallus* Malm., (Hewson, 1970). The large genus *Riccardia* S. F. Gray, 1821, (*Riccardius*), corr. Trevisan, 1874, is richly represented in Australia and New Guinea, there being thirty-eight known species, one of which has two varieties. Associated with the large number of species is considerable confusion. Schuster (1964), ventures to refer to the genus (*sens. str.*) as a "confusing, polymorphic, immense and indigestible group". In attempting to reduce this confusion he has described two new subgenera using two of the Australian species as holotypes for his subgenera:

1. *Riccardia* S. F. Gray (*R. multifida* (L.) S. F. Gray—lectotype).
2. *Phycaneura* Schuster (*R. reducta* Schuster—holotype).
3. *Anomaneura* Schuster (*R. cochleata* (Hook. f. et Tayl.) Kuntze—holotype).

A numerical analysis is herein applied to the thirty-nine taxa found in Australia and New Guinea to attempt to: (*a*) confirm the subgeneric classification set up by Schuster (1963, 1964), or (*b*) create a new subgeneric classification, or (*c*) show that subgeneric classification is not yet advisable with our present knowledge of the genus.

The programme to do this was designed by Dr. W. T. Williams, and the analysis carried out on the Control Data 3600 Computer at Canberra. The raw data for classification consists of a variety of attributes. These mixed attributes can be distinguished into three categories: (1) Numerical (quantitative)—e.g. measurements of length, width, diameter and number of bodies. (2) Ordered multistate—characters in two or more ranked states—e.g. pachydermal cell types and capsule wall anatomy types. (3) Disordered multistate (qualitative)—characters existing in two or more states where no state can be considered intermediate—e.g. presence or absence. Forty-one attributes were coded into these categories as listed in Table 4, for the mixed data numerical analysis.

* Present Address: School of General Studies, Botany Dept., Australian National University, Canberra, A.C.T.

General Analysis and Definitions of Terms used in Description and Numerical Analysis

Thallus: The external morphology of the gametophyte of *Riccardia* has been found to be very variable within and between localities and within and between seasons. The consequent range of variation within and between

Table 1

Species	Length (cm.)		Width (mm.)		Axis			Branch			Branching
	R.	M.	R.	M.	Thick Cells	Margin	TS	Thick Cells	Margin	TS	
A.											
R. geniana	1·0	1·5	0·7	0·3	11	1	1	8	1	1	Irregular
R. alcicornis ..	1·5	1·0	0·4	0·4	10	1	1	10	1	1	Irregular
R. pindaundensis ..	0·5	0·8	0·2	0·3	5	2	2	4	2	2	Irregular
R. ibana	0·5	0·4	0·1	0·1	4	2	2	4	2	2	Irregular
R. aequicellularis ..	1·9	0·6	0·5	0·4	6	2	2	6	2	2	Irregular
B.											
R. phleganiana ..	0·8	0·6	0·7	0·6	4	3	3	4	3	3	Irregular
R. agumana ..	0·8	0·6	0·6	0·4	4	3	3	3	3	3	Irregular
R. bliklika var. *porcina*	0·6	0·7	0·4	0·4	4	3	3	3	3	3	Irregular
R. bliklika var. *bliklika*	0·7	0·7	0·3	0·3	4	3	3	3	3	3	Irregular
R. minima ..	1·0	0·8	0·2	0·3	5	3	3	4	3	3	Irregular
R. babindae ..	0·3	0·5	0·2	0·3	4	3	3	3	3	3	Irregular
C.											
R. umbana	0·5	0·8	0·5	0·8	11	3	4	11	3	4	Irregular
R. tumbareriensis ..	1·5	0·8	1·0	0·8	·10	2	4	9	2	4	Irregular
R. pindensis ..	0·5	0·8	1·5	1·3	7	2	4	6	2	4	Irregular
R. longiflora ..	1·0	1·5	1·0	1·3	8	3	4	8	3	4	Irregular
R. cochleata ..	1·5	1·0	3·0	2·3	8	3	4	8	3	4	Irregular
D.											
R. wattsiana ..	2·5	1·0	1·0	1·0	5	3	3	4	3	3	Irregular
R. argento-limbata ..	5·0	3·5	2·0	2·0	5	3	3	5	3	3	Irregular
R. macdonaldiana ..	2·0	1·5	0·7	0·7	5	3	3	5	3	3	Irregular
R. bipinnatifida ..	2·0	2·0	0·5	1·3	6	2	3	6	2	3	Irregular
R. loriana	1·0	0·8	1·7	0·8	6	3	3	5	3	3	Irregular
R. tenellus	1·0	1·5	0·8	0·6	7	2	2	7	2	2	Irregular
R. hypipamensis ..	1·5	0·8	0·5	0·8	7	2	3	6	2	3	Irregular
R. omkaliensis ..	1·0	1·5	1·0	1·2	12	2	4	12	2	4	Irregular
R. womersleyana ..	1·0	1·5	0·7	0·6	9	1	2	8	1	2	Irregular
R. kowaldiana ..	3·0	2·5	1·5	1·5	10	3	3	10	3	3	Irregular
R. rupicola ..	1·0	1·0	0·6	0·7	6	2	3	5	2	3	Irregular
R. gracilis	0·5	0·8	0·4	0·6	6	2	3	6	2	3	Irregular
R. bongeriana ..	0·5	0·8	0·8	0·6	6	2	3	6	2	3	Irregular
R. gogolensis ..	1·0	1·5	1·5	1·3	8	2	3	7	2	3	Irregular
R. colensoi	4·5	2·0	2·0	1·5	9	2	3	8	2	3	Irregular
R. crassa	3·5	2·0	2·5	1·5	8	2	3	7	2	3	Irregular
R. aspera	3·0	1·5	2·0	1·5	9	2	3	8	2	3	Irregular
E.											
R. robinsii	10·0	5·0	1·0	1·5	35	1	1	5	3	3	Opposite
R. pengagensis ..	6·0	2·0	1·5	1·3	20	1	1	12	2	3	Opposite
R. eriocaula ..	6·0	2·0	0·6	0·7	16	1	1	6	3	3	Opposite
R. australis	4·0	3·0	1·0	1·0	12	1	2	7	2	2	Opposite
R. demkarmana ..	2·0	2·0	0·5	0·8	14	1	1	4	3	3	Opposite
R. anguste-alata ..	3·0	2·5	1·0	0·8	12	3	3	6	3	3	Opposite

species has made it difficult to define macroscopic characters of any taxonomic value. (i) Colour: Colour is very variable and, as was observed in *Aneura*, the intensity of green seems to be correlated with habitat, substrate and age of the specimen. (ii) Size: Length and width of the thallus have been

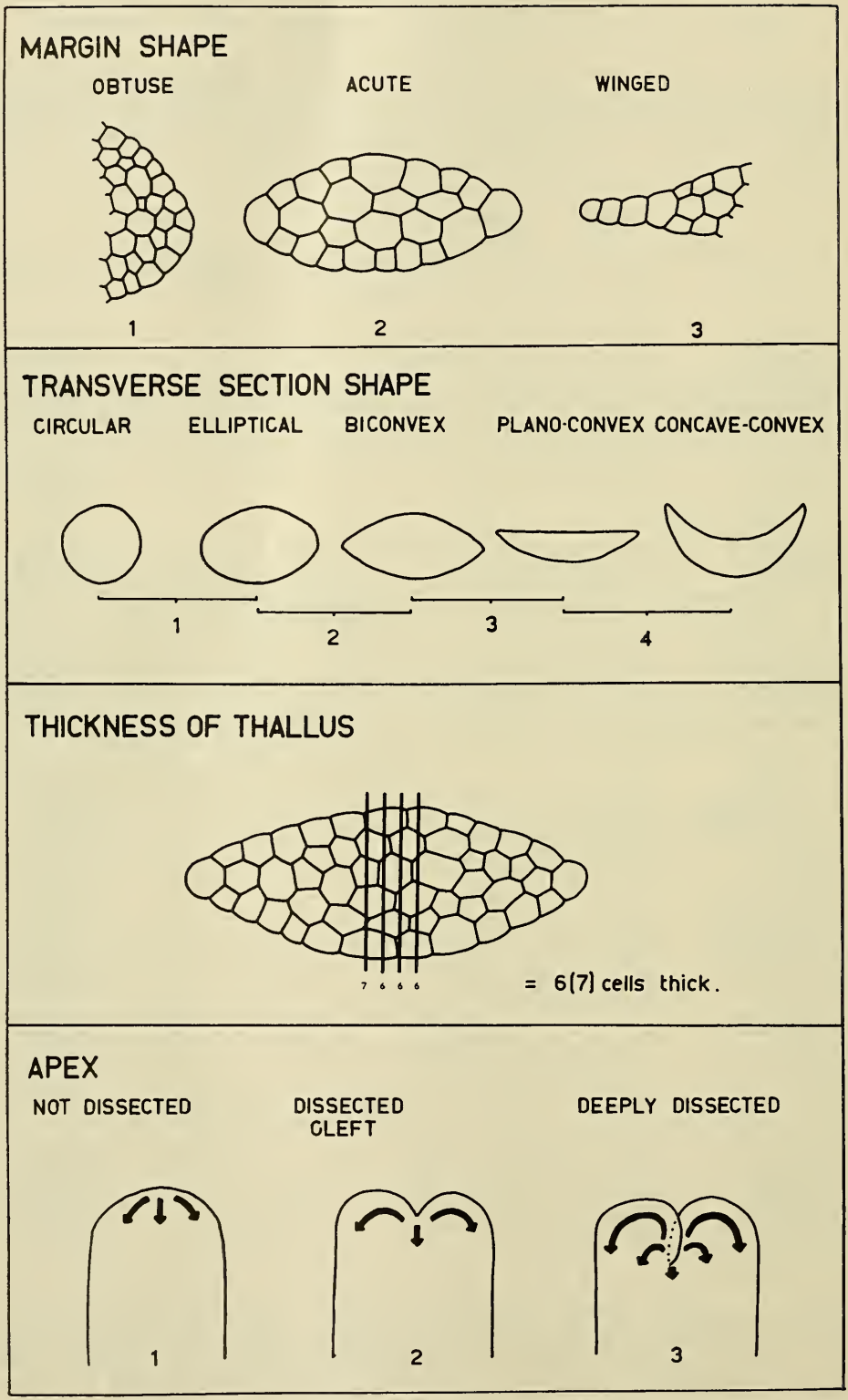


Fig. 1. Explanation of descriptive terminology used for gametophyte characters.

measured. Thickness is described in terms of number of cells deep at the middle of the axis and branches (Fig. 1). (iii) Margin: The margins have been described in two ways. (*a*) Acuteness in transverse section. Three classes are recognized: 1. obtuse, 2. acute and 3. winged (Fig. 1). (*b*) Characteristic form. In some species the marginal epidermal cells are markedly different in shape or wall thickening from the other epidermal cells. (iv) Transverse sectional shape: This shape has been found to vary from circular through to concavo-convex and has been classified into four classes: 1. circular to elliptical, 2. elliptical to biconvex, 3. biconvex to plano-convex and 4. plano-convex to concavo-convex (Fig. 1). (v) Branching: In some species the lateral branches tend to arise opposite each other (e.g. *R. eriocaula*). However in most species the lateral branches arise irregularly or alternately (e.g. *R. crassa*). Branching may be pinnate to quadripinnate and, more rarely, multipinnate. I have interpreted Schuster's classes, ". . . usually freely and regularly branches . . .", and ". . . irregularly branches . . ." as pinnate to quadripinnate, and multipinnate respectively. However the latter are not used in the numerical analysis. The branches tend to arise irregularly in most species with resultant irregular degree of dissection. Consequently these classes tend to become meaningless, and the degree of dissection is not used in the numerical analysis. (vi) Apices: The position of the apical cell has been described in three classes—1. not dissected, 2. dissected (cleft), and 3. deeply dissected (Fig. 1). The position of the apical cell results from the differential growth of the tissue immediately behind the apical cell. If the tissue grows at a uniform rate then the apex is not dissected and the apical cell is not deeply protected. If the tissue lateral to the apical cell grows faster than the tissue behind the apical cell, then it progresses beyond the apical cell and the apex is dissected or cleft. Finally, if the tissue lateral and mid-lateral to the apical cell grows very much faster than the tissue behind the apical cell, then it progresses beyond the apical cell and so the apex is deeply dissected and the apical cell is deeply protected. (vii) Mucilage papillae: The mucilage papillae can be characterised in several ways. Typically they are produced ventral and acropetal behind the apical cell and function to protect it. However, they are absent in *R. geniana* and unconfirmed in *R. eriocaula*. In *R. babindae* they were found to be lateral only and to have a characteristic branched shape. In *R. aequicellularis* they were found to be dorsal, lateral and ventral. Finally some species tend to have the papillae persist in two ventral rows (e.g. *R. minima*). (viii) Rhizoids: Typically the rhizoids are produced on the ventral side of the thallus. However their presence has not been confirmed in all species. On the other hand they are produced both dorsal and ventral on the thallus of some species (e.g. *R. wattsiana*). (ix) Epidermal cells: The epidermal cells in some species were found to be atypical. *R. colensoi* has raised papillate cells, and *R. eriocaula* has some epidermal cells which are elongate to hairlike. (x) Cuticle: The cuticle is characteristically smooth, but *R. aspera, R. crassa* and *R. pindaundensis* are exceptions. (xi) Gemmae: These are two celled structures which are produced endogenously in the epidermal cells and function in asexual reproduction. They have not been observed in all species and are not always produced by those species known to be capable of producing them. Since absence as recorded does not mean they are never produced, no significance can be attached to absence.

A study of gemma production has been made in *R. cochleata*. It was found that each epidermal cell is capable of producing more than one gemma. The epidermal cell undergoes an initial division (usually transverse relative to the cell) to produce two new cells: a dorsal gemma mother cell and a

ventral pro-gemma mother cell. The gemma mother cell then undergoes a division (usually longitudinal) to produce a gemma. The pro-gemma mother cell also undergoes a division (usually longitudinal) to produce a gemma mother cell and a new pro-gemma mother cell, and so on (Fig. 2 and Plate II).

(xii) Mycorrhizae: Mycorrhizae have been observed in *R. kowaldiana, R.*

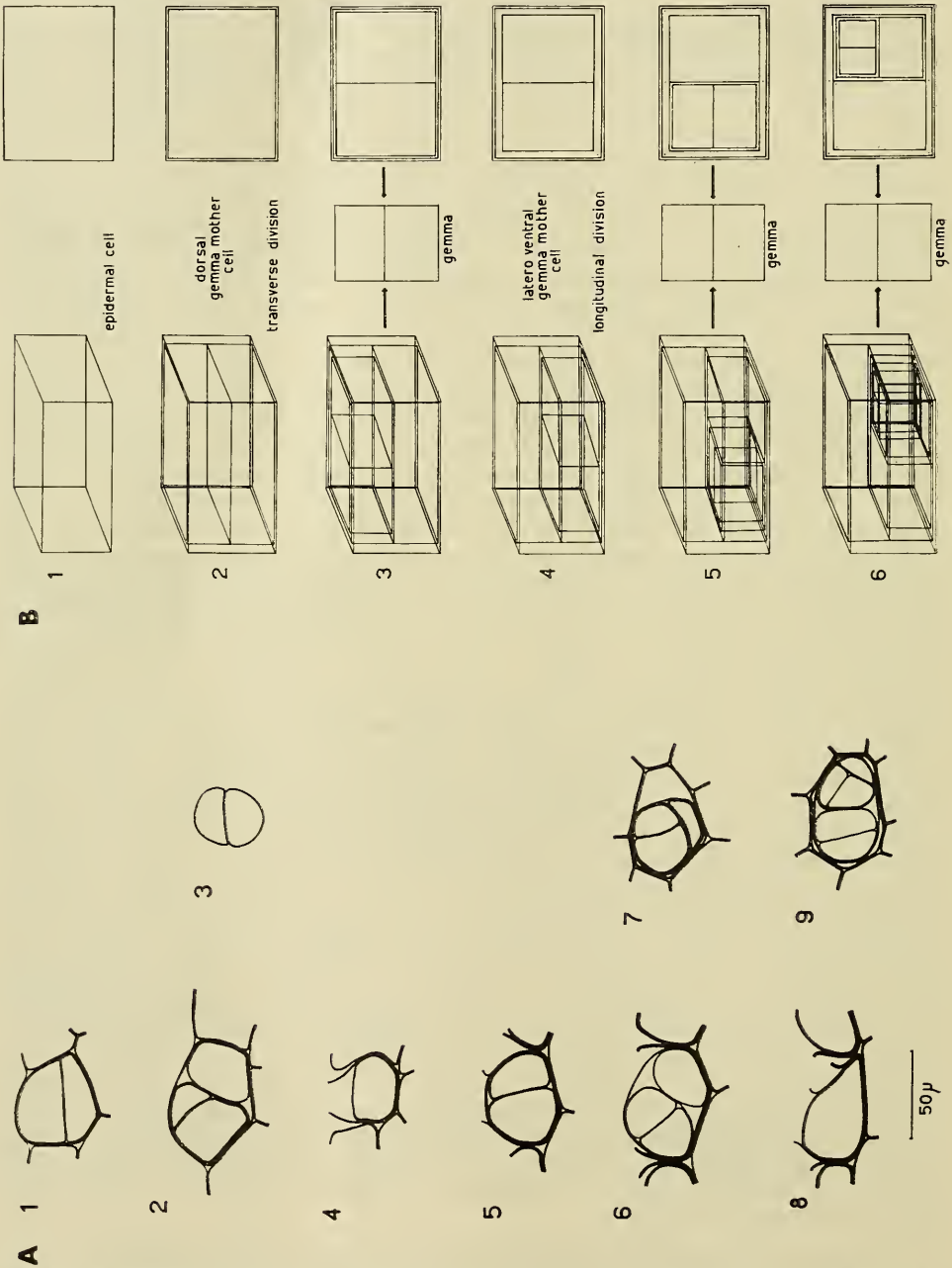


Fig. 2. Gemma production in *R. cochleata*: A. 1–2. Production of the first gemma. 3. Gemma. 4–9. Production of subsequent gemmae. B. 1–3. Model of production of first gemma. 4–6. Model of production of subsequent gemmae.

omkaliensis, R. pindensis, R. tumbareriensis and *R. umbana.* These mycorrhizae are typical of the mycorrhizae found in *Aneura* and *Cryptothallus,* being of the orchid type. The hyphae are septate, enter through the rhizoids and variously infect the epidermal and internal cells. They pass from one cell to another constricting to do so, and form complex hyphal coils which are ultimately digested (Plate II). The width of the hyphae varies from 1·5 to 5·0 μ. However no species regularly has all hyphae fine as in *Aneura rodwayi,* (Hewson, 1970). (xiii) Oil bodies: Oil body characters (number and size), have been found to be useful in subgeneric classification in the genus *Aneura.* Schuster (1963, 1964) uses consistent absence of oil bodies in *R. reducta* to define the subgenus *Phycaneura* and to differentiate it from *Anomaneura* and *Riccardia* where oil bodies are consistenly present. However it seems that *R. reducta* belongs to the species *R. aequicellularis* and oil bodies are rare but no consistently absent. No attempt has been made to use oil bodies to differentiate *Anomaneura* from *Riccardia* and its is questionable that they can be used above species definition.

Sexual Reproduction: (i) Oecy: Four species were found to be monoecious. The chromosome numbers of two of these species are known and are consistently n = 20. This is double the usual haploid number, and it is predictable that monoecy is correlated with diploidisation of the gametophyte.

Male branches are produced first. However, often the male branches secondarily produce archegonia, thus giving rise to paroecious branches. (ii) Male branches: The male branches are special lateral branches which produce antheridia in acropetal succession regularly in two rows. Each branch has a dorso-lateral wing which has a characterisic width for each species (Fig. 3). (iii) Female branches: The position of the female branch ranges between latero-ventral and lateral. The archegonia are therefore presented in a range of positions between latero-ventral and dorsal (Fig. 3). The shape of the branches ranges between reduced, cup-shaped and elongate. When they are elongate the production of the archegonia in acropetal succession in two rows is obvious. The archegonia are protected by a dorso-lateral fringe of hairlike to scalelike paraphyses.

Calyptra: (i) Size: The calyptra has been described for length, and thickness (in number of cells, not including pachydermal cells). (ii) Calyptra armation: The surface of the calyptrae are invested with various distributions of cells or groups of cells. These cells are called the pachydermal cells. In their treatment of the Japanese *Riccardiae*, Mizutani and Hattori (1957), described two types of pachydermal armature. These are (*a*) the *Trichostylium*-type found in the genus *Aneura* and (*b*) the *Riccardia*-type found in the genus *Riccardia.* However the Australian *Riccardiae* exhibit a wider range of pachydermal armature. The types are defined as follows: (*a*) apical pachydermal cells—umbo cells. 1. umbo of loosely aggregated cells—rough. 2. umbo of smooth boss of cells—smooth. 3. umbo of ring of pilose hairs—ciliate. (*b*) scattered pachydermal cells. 1. absent. 2. (*a*) large scattered isodiametric cells (*R. multifida*-group). 2. (*b*) elongate scattered cells (*R. sinuata*-group—unobserved in Australian and New Guinea species). 3. aggregated into short multicellular groups (*R. miyakeana*-group). 4. aggregated into elongate multicellular groups (Plate III). The cuticle of the pachydermal cells of many species was found to be armed with striations while other gametophyte epidermal cells exhibited smooth cuticle.

Sporophyte: (i) Seta: The seta in *Riccardia* has four central cells surrounded by twelve external cells, i.e. four cells in diameter (Fig. 3). This is a discrete character separating the genus *Aneura* from the genus *Riccardia.* There does not seem to be any exception to the sixteen rows of

TABLE 2

Species	Margin Characteristic	Apices	Mucilage Papillae: Abnormal	Ventral	Lateral	Dorsal	Persistent	Epidermal Cell Characteristic	Cutiele Armed	Gemmae	Mycorrhizae	Oecy	Chromosomes-n	Oil Bodies: Number per Cell	Size (μ)
A.															
R. geniana	−	1	Absent					−	−	?	−	D	10	?	
R. alcicornis	−	1	−	+	−	−	+	−	−	?	−	D	?	?	
R. pindaundensis	−	1	−	+	−	−	+	−	+	?	−	D	10	?	
R. ibana	−	1	−	+	+	−	−	−	−	+	−	D	10	0-1	5×8–10×15
R. aequicellularis	−	1	−	+	+	+	−	−	−	+	−	D	10	0–1(2)	5×5–8×15
B.															
R. phleganiana	−	2	−	+	−	−	+	−	−	+	−	D	10	0–2	10×15–10×40
R. agumana	−	2	−	+	−	−	+	−	−	+	−	D	?	?	
R. bliklika var. *porcina*	−	1	−	+	−	−	+	−	−	+	−	D	10	?	
R. bliklika var. *bliklika*	−	1	−	+	−	−	−	−	−	+	−	M	20	(0)1–3(4)	5×5–10×25–20×20
R. minima	−	1	−	+	+	−	+	−	−	+	−	D	10	?	
R. babindae	−	1	+	−	+	−	+	−	−	+	−	D	10	1–2(3)	6–10×6–25 3– 6×20–40
C.															
R. umbana	+	3	−	+	−	−	+	−	−	+	+	M	?	?	
R. tumbareriensis	+	3	−	+	−	−	−	−	−	+	+	D	?	?	
R. pindensis	−	2	−	+	−	−	−	−	−	?	+	D	10	?	
R. longiflora	+	3	−	+	−	−	−	−	−	?	−	D	?	?	
R. cochleata	+	3	−	+	−	−	−	−	−	+	−	D	10	1–2	(6) 8–12(13) (8)15–20(24)
D.															
R. wattsiana	−	2	−	+	−	−	+	−	−	+	−	M	20	(0)1–10(15)	3× 3–25×30 15×45
R. argento-limbata	+	1	−	+	−	−	+	−	−	+	−	D	10	1–6	8×8–15×20–15×35
R. macdonaldiana	−	1	−	+	−	−	+	−	−	+	−	D	10	0–3(4)	5×8–15×20–10×40
R. bipinnatifida	−	2	−	+	−	−	+	−	−	+	−	D	10	(0)1–3(4)	5×5–15×20
R. loriana	−	2	−	+	−	−	−	−	−	?	−	D	10	0–1	10×10–25×35
R. tenellus	−	1	−	+	−	−	−	−	−	+	−	D	10	?	

TABLE 2—*Continued*

Species	Margin Characteristic	Apices	Mucilage Papillae: Abnormal	Ventral	Lateral	Dorsal	Persistent	Epidermal Cell Characteristic	Cuticle Armed	Gemmae	Mycorrhizae	Oecy	Chromosomes-n	Oil Bodies: Number per Cell	Size (μ)
R. hypipamensis	—	2	—	+	—	—	—	—	—	?	—	D	10	2–12	3× 3–7×7–3×8
R. omkaliensis	—	2	—	+	—	—	—	—	—	+	+	D	10	(0)1(2)	8×10–12×15
R. womersleyana	—	1	—	+	+	—	+	—	—	+	—	D	?	?	
R. kowaldiana	—	3	—	+	—	—	+	—	—	+	+	D	10	?	
R. rupicola	—	2	—	+	—	—	—	—	—	+	—	D	10	(0)1(2)	10×10–15×25
R. gracilis	—	2	—	+	—	—	—	—	—	+	—	M	?	?	
R. bongeriana	—	1	—	+	—	—	—	—	—	+	—	D	10	?	
R. gogolensis	—	2	—	+	—	—	+	—	—	+	—	D	10	?	
R. colensoi	—	3	—	+	—	—	—	+	—	?	—	D	?	0–2	5–10 10–15×15–25
R. crassa	—	3	—	+	—	—	—	—	+	+	—	D	10	0–1 1–3	5–15× 8–20 12–20×15–30 & 0–1, 5–12×40–150
R. aspera	—	2	—	+	—	—	—	—	+	?	—	D	10	(0)1(2)	(8)10–20(25)× (15)20–25(30)
E.															
R. robinsii	—	1	—	+	—	—	+	—	—	?	—	D	?	?	
R. pengagensis	—	1	—	+	—	—	—	—	—	?	—	D	10	0–1(2)	10×10–15×20
R. eriocaula	—	1	Absent					+	—	?	—	D	?	?	
R. australis	—	1	—	+	—	—	—	—	—	?	—	D	?	?	
R. demkarmana	—	1	—	+	—	—	+	—	—	+	—	D	10	0–12	2×3–3×15
R. anguste-alata	—	1	—	+	—	—	+	—	—	?	—	D	10	?	

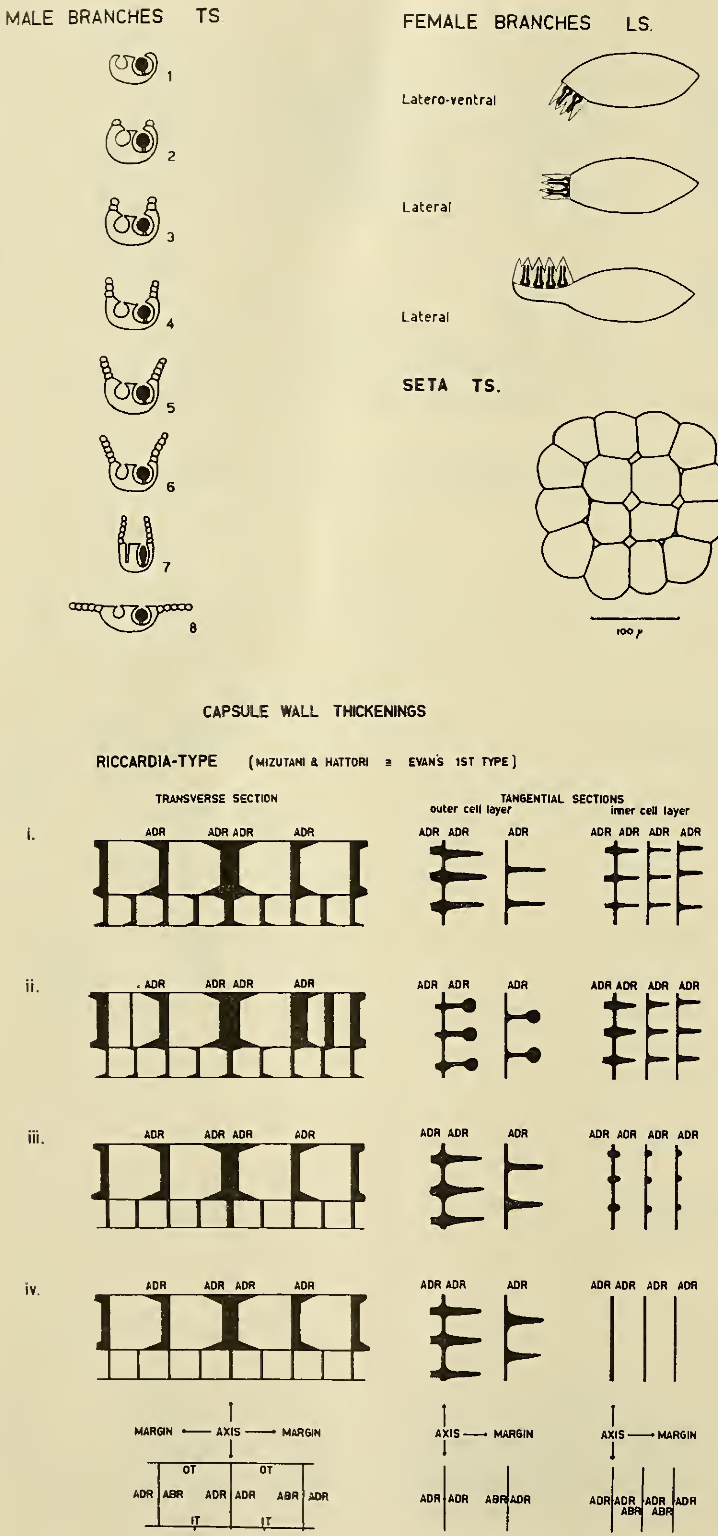


Fig. 3. Male Branches—Dorso-lateral Wing. 1. Absent e.g. *R. alcicornis*. 2. One cell e.g. *R. crassa*. 3. Two cells e.g. *R. bipinnatifida*. 4. Three cells e.g. *R. loriana*. 5. Four cells e.g. *R. kowaldiana*. 6. Five cells e.g. *R. eriocaula*. 7. Tendency to become laterally compressed e.g. *R. eriocaula* and *R. demkarmana*. 8. Tendency to become dorso-ventrally compressed e.g. *R. anguste-alata*.

Female Branches. 1. Latero-ventral e.g. *R. rupicola*. 2. Lateral e.g. *R. hypipamensis*. 3. Lateral e.g. *R. aequicellularis*.

Seta. Transverse Section of *R. aequicellularis* seta.

Capsule Wall Thickenings—*Riccardia*-type. ADR = adaxial radial wall, ABR = abaxial radial wall, OT = outer tangential wall, IT = inner tangential wall.

TABLE 3

Species	Max. No. Anth./b	Dorso-lateral w Width (Mean) ♂	Female Branch Position	Paraphyse Form	Mean Paraphyse Length (mm.)	Max. Length Calyptra	Calyptra Mean Thick Cells	Pachydermal Umb	Pachydermal Sca	Pachydermal Cuticle Armed	Capsule Wall Anatomy	Sexine Pattern Spore	Spore Diameter (μ)
A.													
R. geniana	12	1	—	S	0·10	4·0	10	2	2	+	4	sc	(10)12–18
R. alcicornis	4	0	—	S	0·10	2·5	7	2	1	—	3	p	10–16
R. pindaundensis	8	2	—	HS	0·20	2·0	7	1	2	+	3	p	15–20
R. ibana	10	3	—	HS	0·20	2·5	5	1	2	+	3	sc	8–12
R. aequicellularis	5	0	—	H	0·30	2·0	5	3	1	—	2	sc	8–15
B.													
R. phleganiana	7	3	—	HS	0·30	2·5	5	1	2	+	3	sc	10–15
R. agumana	16	2	—	HS	0·30	3·0	6	1	3	+	3	sc	10–15
R. bliklika var. *porcina*	15	2	—	S	0·15	1·5	4	1	2	+	3	sc	10–15
R. bliklika var. *bliklika*	7	2	—	S	0·15	1·5	4	1	2	+	3	sc	10–15
R. minima	10	1	opp.	HS	0·30	1·5	4	2	1	—	4	sc	7–14
R. babindae	15	1	—	HS	0·20	1·5	5	1	2	+	3	sc	8–12(15)
C.													
R. umbana	10	4	—	S	0·25	1·5	7	1	4	—	3	p	15–20
R. tumbareriensis	6	2	—	HS	0·15	2·0	7	1	3	+	3	sc	10–15
R. pindensis	10	2	—	S	0·10	2·0	6	1	4	+	1	p	14–22
R. longiflora	6	1	—	S	?	8·0	6	1	2	+	?	?	?
R. cochleata	8	1	—	S	0·50	4·0	6	1	3	+	3	sc	10–14(15)
D.													
R. wattsiana	7	3	—	HS	0·70	4·0	5	1	2	+	4	sc	9–14
R. argento-limbata	12	2	—	S	0·60	4·0	10	1	3	+	?	?	?
R. macdonaldiana	25	1	—	HS	0·20	2·5	6	1	2	+	4	sc	10–15
R. bipinnatifida	7	2	—	S	0·20	3·0	6	1	2	+	3	sc	10–15
R. loriana	10	3	—	S	0·20	3·0	9	2	1	+	4	sc	10–15
R. tenellus	16	3	—	S	0·15	3·0	6	1	1	+	4	sc	10–15
R. hypipamensis	10	3	—	S	0·20	3·0	6	1	3	+	4	sc	12–16(20)
R. omkaliensis	8	3	—	S	0·30	4·0	11	2	1	+	4	sc	10–15
R. womersleyana	12	1	—	HS	0·30	4·0	7	1	3	+	3	sc	10–15

TABLE 3—*Continued*

Species	Max. No. Anth./b	Dorso-lateral w Width (Mean) ♂	Female Branch Position	Paraphyse Form	Mean Paraphyse Length (mm.)	Max. Length Calyptra	Calyptra Mean Thick Cells	Pachydermal Umb	Pachydermal Sea	Pachydermal Cuticle Armed	Capsule Wall Anatomy	Sexine Pattern Spore	Spore Diameter (μ)
R. kowaldiana	12	4	—	HS	0·30	4·0	7	2	1	+	3	sc	10–17
R. rupicola	7	1	—	HS	0·35	4·0	7	1	2	++	3	sc	8–12
R. gracilis	6	1	—	S	?	4·0	?	1	3	++	?	?	?
R. bongeriana	8	2	—	HS	0·20	4·0	10	1	3	++	3	sc	12–16
R. gogolensis	20	3	—	HS	0·40	3·0	6	1	3	++	3	sc	10–15
R. colensoi	6	3	—	HS	0·20	3·0	8	1	3	++	3	sc	10–13
R. crassa	6	1	—	HS	0·50	5·0	6	1	2	++	1	sc	10–15
R. aspera	12	2	—	HS	0·50	4·0	7	1	4	+	3	sc	9–14
E.													
R. robinsii	?	?	opp.	S	0·30	?	?	?	?	?	?	?	?
R. pengagensis	10	5	—	S	0·40	3·0	10	2	1	+	?	sc	10–15
R. eriocaula	7	5	opp.	HS	0·30	4·0	5	2	2	+	3	sc	8–13
R. australis	8	3	opp.	S	?	5·0	?	1	2	?	3	sc	10–12(15)
R. demkarmana	6	4	opp.	HS	0·40	4·0	?	2	2	—	4	sc	10–15
R. anguste-alata	12	4	opp.	HS	1·00	4·0	8	1	4	+	3	sc	8–15

cells in the Australian and New Guinea species. However, Schuster (1958, pp. 31, 66) describes the *Riccardia* seta as having only twelve rows of cells. Unfortunately no species is cited and so the observation can not be checked and its significance appreciated. (ii) Capsule wall anatomy: Evans (1937) described two types of distribution of thickenings in the walls of the capsule wall cells of *Riccardia sl.* His first type is found in *Riccardia s. str.*, and Mizutani and Hattori (1957), were able to recognize four categories within it. (1) Bands of thickening on the adaxial radial walls and inner tangential walls (L-shaped) of both the outer and inner cell layer. (2) Bands of thickening as in (1) except that in the outer layer, the bands are nodulose. Mizutani and Hattori cite *R. palmata* as exemplifying this type. However in their description (p. 46), they describe the outer row of cells as having semi-annular thickening and the inner row of cells as having nodular thickenings. This description is probably an error, but if it is not, it represents a fifth type of capsule wall thickening. (3) Bands of thickening on the adaxial radial walls and inner tangential walls of the outer cell layer (L-shaped), and ill-defined bands on the adaxial radial walls of the inner cell layer (I-shaped). (4) Bands of thickening on the adaxial radial walls and inner tangential walls of the outer cell layer (L-shaped) and no bands on the walls of the inner cell layer (Fig. 3 and Plate IV). Types 3 and 4 are difficult to distinguish and, although usually discrete, some species appear to overlap. (iii) Spores: (*a*) *Ornamentation*: As defined in Part I (Hewson, 1970), the spore ornamentation has been found to be of two types: 1. scabrate and 2. papillate (Plate II). (*b*) Size: Spore diameter has been found to have a wider range than previously recorded. Hence it is extended to 7–22 μ.

Chromosomes: Counts have been made on twenty seven species. Ten was found to be the basic haploid number for the genus. However some species were found to be polyploid. *Riccardia wattsiana* and *R. bliklika* var *bliklika* were found to have regularly an haploid number of twenty, and *R. cochleata* and *R. babindae* were found to have some specimens with an haploid number of ten and other specimens with an haploid number of twenty. The cytology will be dealt with in Part III of this treatment.

Distribution: The distribution is to be discussed in Part III of this treatment.

Mixed Data Analysis

To carry out the classificatory analysis on the thirty-nine taxa, forty-one attributes were coded (Table 4) and the information analysed in four programmes. The information statistic in the programme MULTBET (Lance and Williams, 1967) produced an hierarchy of information gain (Fig. 4), and provided the coefficients for the ordination. The ordination (principal co-ordinate analysis, Fig. 5) resulted from the programme GOWER (Gower, 1966). The programme GROUPER (Lance, Milne and Williams, 1968) provided a diagnostic comparison between groups produced in the MULTBET Hierarchy (Table 5). The programme GOWERCOR (Lance, Milne and Williams, 1968) gave a correlation coefficient between the axes in the ordination and the original attributes (Table 6).

The MULTBET Hierarchy and GROUPER Diagnostic Comparison between Groups: The hierarchy indicates that the genus, as represented in Australia and New Guinea, is a relatively homogeneous one. It also indicates that there is no reasonable justification for subgeneric classification.

The most obvious division into subgenera is between group E and group ABCD (Fig. 4). However, from the GROUPER diagnostic comparison (Table 5), it can be seen that there are only two discrete diagnostic characters, viz. thallus differentiation and thallus branching. Thus, all species in group E

have a differentiated thallus with opposite branching, all species in group ABCD have undifferentiated thalli with alternate branching, and there is an overlap between the two groups in all other characters. The next most obvious division is between group AB and group CD within the group ABCD. However there are no discrete diagnostic characters. Group AB tends to include species with narrower thalli than the species in group CD. The next

TABLE 4
Attributes Analysed

Qualitative Attributes

1. Oecy—monoecious/dioecious.
2. Main thallus axis differentiation—not differentiated/differentiated.
3. Marginal cells distinctive from other epidermal cells—not distinctive/distinctive.
4. Mucilage papillae—abnormal/normal.
5. Mucilage papillae—present/absent.
6. Mucilage papillae — persistent/non-persistent.
*7. Mucilage papillae—dorsal/not dorsal.
8. Mucilage papillae—lateral/not lateral.
9. Mucilage papillae — ventral/not ventral.
10. Thallus branching — opposite/alternate.
11. Epidermal cells—characteristic shape/normal shape.
12. Cuticle—armate/smooth.
13. Mycorrhiza—absent/present.
14. Gemmae—absent/present.
15. Gemmae—multicellular/bicellular.
16. Female branches — not opposite/opposite.
17. Female branches — lateral/latero-ventral.

Numerical Attributes

1. Thallus length—mean length.
2. Thallus length—range in length.
*3. Thallus axis width—mean width.
*4. Thallus axis—range in width.

Numerical Attributes—continued

*5. Thallus axis—margin shape.
*6. Thallus axis — transverse section shape.
7. Thallus axis—mean thickness.
8. Thallus branches—margin shape.
9. Thallus branches—transverse section shape.
10. Thallus branches—mean thickness.
11. Thallus apices—relative position of apical cell.
12. Female branches—mean paraphyse length.
13. Male branches—maximum number of antheridia.
14. Male branches—dorso-lateral wing width.
15. Capsules—maximum length.
16. Capsules—mean width of wall.
17. Spores—mean diameter.
*18. Oil bodies—mean number per cell.
19. Chromosomes—haploid number.

Multistate Attributes

1. Paraphyses — hairlike/hairlike and scalelike/scalelike.
2. Pachydermal umbo — ciliate/smooth/rough.
3. Pachydermal cells—absent/scattered/short multicellular/long multicellular.
4. Capsule wall anatomy—Mizutani & Hattori Classification—(i)/(ii)/(iii)/(iv).

*Schuster's (1964) diagnostic characters (except branching).

TABLE 5
GROUPER Diagnostic Comparison between MULTBET Hierarchy Groups

Attribute	Difference
Group E vs Group ABCD.	
Qual. 2—Thallus differentiation	1·000
Qual. 10—Thallus branching	1·000
Qual. 16—Female branching—not opposite/opposite	0·803
Num. 2—Thallus length	0·508
Group AB vs Group CD.	
*Num. 3—Thallus width—mean	0·537
*Num. 4—Thallus width—range	0·530
Group A vs Group B.	
Qual. 17—Female branches—lateral/latero-ventral	0·667
Group C vs Group D.	
Qual. 3—Marginal cells distinctive	0·741
Qual. 18—Spore wall ornamentation	0·500

*Schuster's (1964) diagnostic characters (except branching).

division is between groups A, B, C and D, but there are no discrete diagnostic characters. Thus species in group A tend to have female branches arising latero-ventrally and species in group B tend to have them arising laterally.

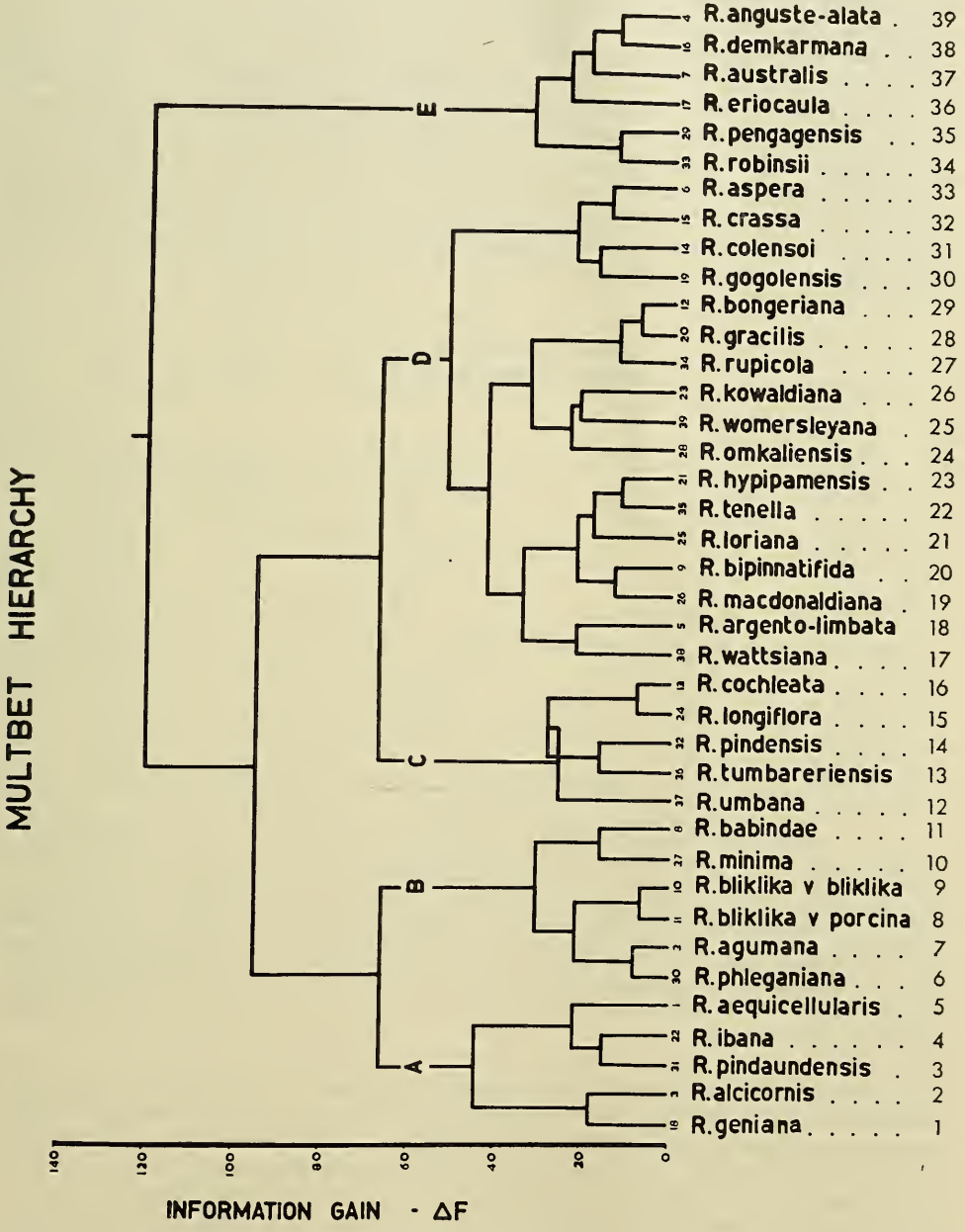


Fig. 4. Multbet hierarchy.

Species in group C tend to have distinctive marginal cell walls and papillate spore wall ornamentation, and species in group D to have normal marginal cell walls and scabrate spore wall ornamentation. It is obvious that the

only clearly definable group is group E. It is obvious too that the characters lending most support to the groups are not (with one exception) those chosen by Schuster for his subgeneric classification.

The GOWER Ordination and GOWERCOR Correlation Coefficient between the Ordination Axes and the Original Attributes: The ordination also indicates that the genus, as represented by the species studied here, is a relatively homogeneous one. Group E is the group most readily recognisable and separable from the somewhat more intricate group ABCD. From a study of the correlation coefficients between the ordination axes 1, 2 and 3 (plotted), and the original attributes it can be seen that the vegetative and reproductive morphology of the gametophyte are the major character types contributing to the ordination. Anatomical and sporophyte characters contribute less but do contribute significantly to the ordination axes 4 and 5 (unplotted). It can also be seen that three of Schuster's diagnostic characters appear to make significant but not major contribution to the ordination.

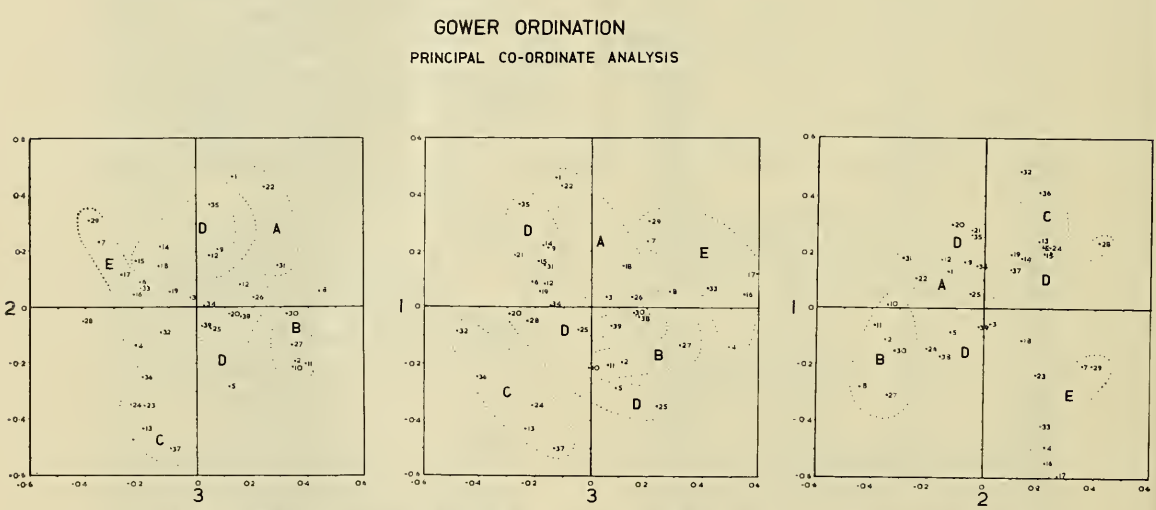


Fig. 5. Gower Ordination Principal Co-ordinate Analysis. 1. *R. aequicellularis.* 2. *R. agumana.* 3. *R. alcicornis.* 4. *R. anguste-alata.* 5. *R. argento-limbata.* 6. *R. aspera.* 7. *R. australis.* 8. *R. babindae.* 9. *R. bipinnatifida.* 10. *R. bliklika* var. *bliklika.* 11. *R. bliklika* var. *porcina.* 12. *R. bongeriana.* 13. *R. cochleata.* 14. *R. colensoi.* 15. *R. crassa.* 16. *R. demkarmana.* 17. *R. eriocaula.* 18. *R. geniana.* 19. *R. gogolensis.* 20. *R. gracilis.* 21. *R. hypipamensis.* 22. *R. ibana.* 23. *R. kowaldiana.* 24. *R. longiflora.* 25. *R. loriana.* 26. *R. macdonaldiana.* 27. *R. minima.* 28. *R. omkaliensis.* 29. *R. pengagensis.* 30. *R. phleganiana.* 31. *R. pindaundensis.* 32. *R. pindensis.* 33. *R. robinsii.* 34. *R. rupicola.* 35. *R. tenella.* 36. *R. tumbareriensis.* 37. *R. umbana.* 38. *R. wattsiana.* 39. *R. womersleyana.*

Conclusion: Both the hierarchy and the ordination indicate that group E is the only discrete and definable group. This leaves a large and relatively homogeneous group ABCD. It is in this group that Schuster's *Phycaneura* and *Anomaneura* fall. However, neither Schuster's diagnostic characters nor any of the other characters analysed here are discrete and diagnostic in the definition of the hierarchy groups AB and CD or A, B, C and D. Similarly they do not provide very significant correlation coefficients in the ordination. However, it would not be unreasonable to suggest that group E be recognized as a subgeneric taxon. Group E is not herein created as a subgenus because it has many more representatives in South America and it would be advisable to incorporate these before doing so.

TABLE 6

GOWERCOR Correlation Coefficients between Ordination Axes and Attributes

Attributes	Coefficient
Axis 1.	
Qual. 16—Female branching—not opposite/opposite	−0·7076
Qual. 2—Thallus differentiation	−0·6772
Qual. 10—Thallus branching—opposite/alternate	−0·6772
Qual. 6—Mucilage papillae persistence	−0·6264
*Num. 6—Thallus axis—TS shape	−0·5656
Num. 11—Thallus apices—apical cell position	0·5311
Num. 2—Thallus length—range	−0·4724
Multst. 2·2—Pachydermal umbo smooth	−0·4622
Num. 1—Thallus length—mean	−0·4572
Axis 2.	
Num. 10—Thallus branches thickness—mean	0·7411
Num. 7—Thallus axis thickness—mean	0·6399
*Num. 3—Thallus axis width—mean	0·5856
Num. 15—Capsule length	0·5522
*Num. 4—Thallus axis width—range	0·5310
Num. 16—Capsule wall width—mean	0·5190
Qual. 2—Thallus differentiation	0·5053
Qual. 10—Thallus branching—opposite/not opposite	0·5053
Num. 5—Thallus axis—margin	−0·5000
Axis 3.	
Qual. 3—Marginal cell distinctiveness	−0·6277
*Num. 6—Thallus axis TS shape	−0·5919
Num. 9—Thallus branches TS shape	−0·5865
*Num. 5—Thallus axis margin	−0·5769
Qual. 17—Female branches—lateral/not lateral	0·5399
Num. 8—Thallus branch margin	−0·5056
Axis 4.	
Qual. 18—Spore ornamentation	−0·5544
Num. 12—Paraphyse length	−0·5128
Multst. 3·4—Pachydermal cells—elongate multicellular	0·4696
Axis 5.	
Multst. 4·4—Capsule wall anatomy, M & H (iv)	−0·6364
Multst. 1·3—Paraphyses—scalelike	−0·5926
Multst. 1·2—Paraphyses—hairlike and scalelike	0·5629
Multst. 4·3—Capsule wall anatomy, M & H (iii)	0·5489
Multst. 3·1—Pachydermal cells—no scattered cells	−0·5050

*Schuster's (1964) diagnostic characters (except branching).

GENERIC DESCRIPTION

RICCARDIA S. F. Gray, "Nat. Arr. Brit. Pl.," 1: 679, 683 (1821) (*Riccardius*), corr. Trevisan in *R. Ist. Lombardo Sci. Lett. Milano*, 2 (7): 785 (1874) nom. cons.

Orthographic Variant: *Riccardius* S. F. Gray, "Nat. Arr. Bri. Pl.," 1: 679, 683 (1821).

Nomenclatural Synonyms: *Roemeria* Raddi, "Jungermanniografia Etrusca.," 35 (1818), et *Mem. Soc. Ital. Sci. Modena.*, 18: 46 (1820), non *Roemeria* Medikus, nec *Roemeria* Moench, nec *Roemeria* Thunberg; *Metzgeria* Corda, Opiz, *Beitrage zur Naturgeschichte*, 654 (1828–9), non *Metzgeria* Raddi; *Gymnomitrion* Hübener, "Hepat. Germ.," 37 (1834), non *Gymnomitrion* Corda; *Pseudoneura* Gottsche, *Danske. V.S. Skrift.*, 6: 259 (1867).

Taxonomic Synonyms: *Jungermannia* Linnaeus, "Sp. Pl.," 2: 1136 (1753) p.p., excl. lectotype. *Acrostolia* Dumortier, "Rec. d'Obs. Jungermanniacees.," 211 (1835); *Sarcomitrium* Corda in Sturm, "Deutschlands Flora.," 2: 119 (1835); *Spinella* Schiffner et Gottsche, *Exped. Gazelle, Bot.*, 4: 42 (1890).

Misapplied Names: *Rhyzophyllum* (non Palisot de Beauvois, "Florae de Oware.," 22 (1804)), Schiffner, in Engler & Prantl, "Pflanzenfamilien.," 1.3.1: 52 (1893) (as *Rhizophyllum*).

Dioecious or monoecious. *Plants* prostrate to erect on damp or wet rock, soil, or wood. *Thalli* pale to dark green, may or may not be differentiated into an erect rigid axis and lateral photo-synthetic branches, 0·1–12·0 cm. long, 0·05–4·0 mm. wide, with obtuse to acute winged margins, circular to deeply concavo-convex in transverse section, (3)5–15 (up to 40 in axes of species with differentiated laminae) cells thick; branching pinnate to quadripinnate (to multipinnate); apices rounded to deeply dissected; mucilage papillae ventral, ± lateral, rarely dorsal, ± persistent in two ventral acropetal rows; rhizoids present or absent, usually ventral; cuticle smooth or striate. *Gemmae* two celled, endogenous. *Mycorrhizae* present in some species. *Oil bodies* 0–12 per cell, 2 × 3 – 25 × 35 – 12 × 150 μ. *Male plants* with lateral male branches; antheridia arranged in acropetal succession in two regular rows of up to 25 antheridia per row; dorso-lateral wing up to 6 cells wide. *Female plants* with latero-ventral to lateral female branches; paraphyses hairlike to scalelike, arranged around the archegonia. *Calyptra* 0·5–8·0 mm. long, 3–12 cells thick; pachydermal ornamentation of the *Riccardia*-type. *Seta* of the *Riccardia*-type with 16 rows of cells, 4 central and 12 external. *Capsule wall thickenings* of the *Riccardia*-type. *Spores* 7–22 μ in diameter, minutely sculptured with scabrate "projections", or papillate projections. *Haploid chromosome number*: 10 or 20.

Typification: *Riccardia* S. F. Gray—Lectotype—*R. multifida* (L.) S. F. Gray, (*Jungermannia multifida* Linnaeus) = *Roemeria* Raddi, non *Roemeria* Medikus, nec *Roemeria* Moench, nec *Roemeria* Thunberg—Lectotype—*R. multifida* (L.) Raddi.

1. *Riccardia geniana** Hewson, sp. nov.

* This spelling of the specific epithet has been deliberately adopted.

Dioica. Thallus parvus, 1–2 cm. longus, 0·1–0·5 (0·8) mm. latus, cylindratus vel biconvexus, 5–15 cellulis crassitie, margine obtuso; ramificatio bi-(tri-) pinnata; apices non dissecti; papillae mucilagineae nulla. *Cuticula* laevis. *Rami plantarum* masculinarum laterales; antheridia in seriebus 2 regularibus ordinatis; alae 0–1(2) cellula latitudine. *Rami plantarum femininearum* squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 4 mm. longa, 8–13 cellulis crassitie; cellulae pachydermaticae dispersi et in umbone terminali. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iv) similis. *Sporae* (10) 12–18 μ crassae. *Chromosomata gametophytica*: ? 10.

Dioecious. Plants in dense mats on granite soil in alpine grassland or creek banks in sub-alpine rainforest, usually in seepages or submerged in running water; axis usually prostrate, biconvex and the branches upright-cylindrical. *Thalli* 1–2 cm. long, 0·1–0·5 (0·8) mm. wide with obtuse margins, cylindrical to biconvex in transverse section; 5–15 cells thick; branching bipinnate rarely tripinnate; apex not dissected; mucilage papillae absent; rhizoids not observed; cuticle smooth. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* bearing lateral antheridial branches on main axis or pinnae; antheridia in two rows, up to 12 per row; dorso-lateral wing 0–1(2) cells wide. *Female plants* bearing archegonial branches lateral on main axis or pinnae; archegonia in two rows; paraphyses reduced, multicellular, scalelike. *Calyptra* up to 4 mm. long, 8–13 cells thick; pachydermal cells scattered and in smooth terminal umbo; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* (10)12–18 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: ? n = 10.

Typification: *Riccardia geniana*—Holotype—3,650 m. between L. Aunde and L. Pinde, Mt. Wilhelm, Chimbu District, New Guinea, in running water,

Hewson, 611, 8.1965, (NSW): Isotypes (LAE. L). Named in honour of Godfries Gene who was one of my guides on Mt. Wilhelm.

Specimens Examined: New Guinea: Komamamambuno, 2,600 m., Mt. Wilhelm, Hewson, 580, 8.1965, (SYD. LAE. L); L. Aunde, 3,500 m., Mt. Wilhelm, Hewson, 599, 602, 608, 615, 616, 625, 629, 636, 8.1965, (SYD. LAE. L); Brass Tarn, 3,800 m., Mt. Wilhelm, Hewson, 648, 650, 651, 652, 654, 655, 658, 661, 662, 663, 666, 8.1965, (SYD. LAE. L).

Distribution: New Guinea: 2,400–3,800 m.

2. *Riccardia alcicornis*

Riccardia alcicornis (Hook. f. et Tayl.) Trevisan in *R. Ist. Lomb. Sci. Lett.* Milano, 3 (4): 431 (1877); Evans in *Trans. Conn. Acad. Arts and Sci.*, 25: 148 (1921); Schuster in *J. Hatt. Bot. Lab.*, 26: 295 (1963), as *Riccardia alcicorne* (Hook. f. et Tayl.) Trevis., Schuster in *J. Hatt. Bot. Lab.*, 27: 212 (1964).

Nomenclatural Synonyms: *Jungermannia alcicornis* Hook. f. et Tayl. in *Lond. J. Bot.*, 3: 479 (1844); Tayl. et Hook. f. in Hook. f., "Botany of the Antarctic Voyage, Flora Antarctica," I, 2: 444 (1847).

Aneura alcicornis (Hook. f. et Tayl.) Gottsche in Gottsche, Lindenberg and Nees, "Syn. Hep.," 499 (1846); Stephani, "Sp. Hep.," 1: 264 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 64 (1917) (as *A. alcicorne*).

Sarcomitrium alcicorne (Hook. f. et Tayl.) Mitten in Hook. f., "Botany of the Antarctic Voyage, Flora Tasmaniae," III, 3: 239 (1860); Bastow in *P. & Proc. Roy. Soc. Tas.*, 1887: 274 (1888).

Taxonomic Synonym: *Aneura subnigra* Stephani, in *Kungl. Svenska Vet.-Akad. Handl.*, 46: 9 (1911), et "Sp. Hep.," 6: 43 (1917); synonomy proposed by Evans in *Trans. Conn. Acad. Arts & Sci.*, 25: 148 (1921).

Dioecious. Plants growing in cushions on soil usually with other Bryophytes. *Thalli* 0·5–1·5 (2) cm. long, (0·2) 0·3–0·5 (0·6) mm. wide, with obtuse (rarely acute) margin, elliptical in cross section, 8–12 cells thick; branching bi- to quadri- (multi-) pinnate; apex rounded to slightly cleft but not dissected, protected by mucilage papillae which surround it and tend to persist in an irregular way, i.e., (i) lateral for a short distance, (ii) very rarely dorsal, and (iii) always ventral in two irregular rows; cell walls ± thickened and brown pigmented throughout the thallus; cuticle smooth. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* bearing antheridial branches 2–3 together laterally on thallus; antheridia in two rows, up to 4 per row; dorso-lateral wing one cell wide when present. *Female plants* bearing lateral cup-shaped archegonial branches, two rows of archegonia; paraphyses multicellular, dentate to fimbriate, scalelike, occasionally between the archegonia, but usually surrounding them. *Calyptra* 1–2·5 mm. long, 5–8 cells thick; pachydermal cells in a smooth terminal umbo; cuticle smooth. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–16 μ in diameter, with papillate projections. *Chromosomes* unknown.

Typification: *Aneura alcicornis* Hook. f. et Tayl.—Holotype—Cape Horn, sine leg., sine no.: Isotypes (NY ex Hb. Mitten, Hodgson NZ).

Specimens Examined: Cape Horn: (Dr. Taylor), sine No., (NY ex Hb. Mitten, Hodgson NZ); Tasmania: Cleame Tarn, Mt. Field National Park, Willis, 10. 12.1952, (MEL); Lake Dobson, Mt. Field National Park, Hewson, 239, 9.1963, (SYD).

Distribution: Cape Horn, Tasmania.

3. *Riccardia pindaundensis* Hewson, sp. nov.

Dioica. Thallus pusillus, 0·5–1·0 cm. longus, 0·2–0·3 (0·4) mm. latus, ellipticus vel biconvexus, 3–6 cellulis crassitie, margine obtuso vel acuto; ramificatio bi- vel tripinnata; apices non dissecti; papillae mucilagineae, ventrales, persistentes in seriebus 2 regularibus ordinatis. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 1–2 cellula latitudine. *Rami plantarum feminearum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 1–2 mm. longa, 5–8 cellulis crassitie; cellulae pachydermatici in fasculi. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 15–20 μ crassae, papillatae. *Chromosomata gametophytica* ? 10.

Dioecious. Plants in dense cushions in running water in alpine grassland. *Thalli* 0·5–1·0 cm. long, 0·2–0·3 (0·4) mm. wide, with obtuse to acute margin, elliptical to biconvex in transverse section, 3–6 cells thick; branching bi- to tripinnate, rarely quadripinnate; apex not dissected, protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle armed with fine dentition. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows; up to 8 per row; dorso-lateral wing 1–2 cells wide. *Female plants* bearing archegonial branches lateral on main axis and pinnae; archegonia in two rows, protected by multicellular, scalelike and hairlike paraphyses. *Calyptra* 1–2 mm. long, 5–8 cells thick; pachydermal cells in multicellular clusters; cuticle armate. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Seta* of the *Riccardia*-type. *Spores* 15–20 μ in diameter, papillate. *Chromosome number*: ? n = 10.

Typification: *Riccardia pindaundensis*—Holotype—3,650 m., in running water in gully into Lake Pinde, Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 621, 8.1965, (NSW): Isotypes (LAE. L). Named after the Australian National University Research Station (Pindaunde), on Mt. Wilhelm.

Distribution: New Guinea: 3,600-3,700 m.

4. *Riccardia ibana* Hewson, sp. nov.

Dioica. Thallus pusillus, 1·0–6·0 mm. longus, 0·05–0·20 mm. latus, cylindratus vel biconvexus, 3–5 cellulis crassitie, margine obtuso vel acuto; ramificatio bi- vel tripinnata; apices non dissecti; papillae mucilagineae ventrales, plus minusve laterales, non persistentes. *Cuticula* laevis. *Corpora oleosa* 0–1 in quaque cellula, 5 × 8–10 × 15 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatus; alae 1–3 cellula latitudine. *Rami plantarum feminearum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 1·5–2·5 mm. longa, 4–6 cellulis crassitie; cellulae pachydermatici plus minusve fasciculi apicales et in umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 8–12 μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants in velvety mats on soil often in disturbed and exposed areas. *Thalli* 1·0–6·0 mm. long, 0·05–0·2 mm. wide, margins obtuse to acute, circular to elliptical or biconvex in transverse section, 3–5 cells thick; internal cell walls ± thickened; branching bi- to tripinnate; apices not disected, protected by ventral, ± lateral, non-persistent mucilage papillae; rhizoids not observed; cuticle smooth. *Gemmae* produced in the epidermal cells but not restricted to apical region. *Oil bodies* 0–1 per cell but rare in epidermal cells, globular, 5 × 8–10 × 15 μ. *Male plants* bearing antheridia in two rows, up to 10 per row; dorso-lateral wing 1–3 cells wide, dentate. *Female plants* bearing archegonial branches lateral on main axis and pinnae; archegonia in two rows, protected by multicellular, hairlike and scalelike paraphyses. *Calyptra*

1·5–2·5 mm. long, 4–6 cells thick; pachydermal cells ± in few apical wartlike, multicellular clusters and a rough terminal umbo; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 8–12 μ in diameter, minutely sculptured scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia ibana*—Holotype—on clay soil, 2,400 m., Mt. Kaindi, Edie Creek, Morobe District, New Guinea, Hewson, 784, 8.1965, (NSW): Isotypes (LAE. L). Named in honour of Iba who was my chief guide at Kagua, and who was a small neat man.

Specimens Examined: New Guinea: Tumbareri, Kagua, Hewson, 689, 8.1965, (SYD. LAE. L); Wakaru Range, Kagua, Hewson, 692, 699, 705, 707, 8.1965, (SYD. LAE. L); Mungeri, Kagua, Hewson, 722, 8.1965, (SYD. LAE. L); Blue Nose Point, Edie Creek, Hewson, 765, 8.1965, (SYD. LAE. L); Mt. Kaindi, Edie Creek, Hewson, 783, 785, 787, 804, 806, 816, 8.1965, (SYD. LAE. L); to Bulldog Track, Edie Creek, Hewson, 818, 828, 9.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,600–2,500 m.

5. *Riccardia aequicellularis* (Stephani) Hewson, comb. nov.

Nomenclatural Synonym: *Aneura aequicellularis* Steph. in *J. Proc. Roy. Soc. N.S.W.*, 48: 95 (1914).

Taxonomic Synonyms: *Aneura filiformis* Steph,. "Sp. Hep.," 6: 26 (1917). *Riccardia reducta* Schust. in *J. Hatt. Bot. Lab.*, 26: 294 (1963).

Misapplied Names: *Aneura bipinnata* (non (Swartz.) Trevis.), Stephani in *J. Proc. Roy. Soc. N.S.W.*, 48: 95 (1914). *Aneura minima* (non (Carr. et Pear.), Steph.), Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 65 (1917). *Aneura gracilis* (non Steph.), Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 65 (1917). *Aneura perpusilla* (non Col.), Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 65 (1917).

Dioecious. Plants small, usually in dense mats on wet soil, rock, bark or wood, often mixed with other Bryophytes especially members of the family Lepidoziaceae. *Thalli* (0·1) 0·2–1·0 (2·0) cm. long, (0·1) 0·2–0·5 (0·6) mm. wide with obtuse to acute margin, elliptical to biconvex in transverse section, (4) 5–7 (8) cells thick; branching bi- to tri- (quadri-) pinnate; apex not dissected, protected by mucilage papillae which surround it but are not persistent; epidermal cells as large or larger than internal cells; rhizoids not observed; cuticle smooth. *Gemmae* present in some specimens. *Oil bodies* in epidermal cells only, 0–1 (2) per cell, 5 × 5–8 × 15 μ. *Male plants* with antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 5 per row; dorso-lateral wing absent. *Female plants* bearing archegonia lateral in elongate branches, with two rows of archegonia presented dorsally; paraphyses unicellular, cilia-like, up to 200 μ long. *Calyptra* 1–2 mm. long, 4–6 cells thick; pachydermal cells a crown of cilia-like cells which arise from a terminal umbo, cuticle smooth. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (ii). *Spores* 8–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Aneura aequicellularis* Steph.—Holotype—Wentworth Falls, NSW, Watts, 117, 10.1912 (G11039). *Aneura filiformis* Steph.—Holotype—Tasmania, Weymouth, 1126, (G11041 ex Hb. Levier 5464).

Specimens Examined: Tasmania: 900 m., Wellington Falls, Rodway, sine no., 11.1896, (HO 29 ex Hb. Rodway); Adventure Bay, sine leg., sine no., 3.1921, (HO 29 ex Hb. Rodway); Guy Fawkes River, sine leg., sine no., 9.1913, (HO 29 ex Hb. Rodway); Fern Glade, Mt. Wellington, Berrie, 123, 5.1963, (SYD); Pipe Line Track, Mt. Wellington, Berrie, 126, 5.1963, (SYD);

Hewson, 278, 9.1963, (SYD); Huon River, Mt. Hartz National Park, Berrie, 131, 132, 135A, 5.1963, (SYD); Hewson, 209, 210, 211, 212, 217, 218, 220, 222, 9.1963 (SYD); Arve Bridge, Mt. Hartz National Park, Hewson, 229, 230, 9.1963, (SYD); Road to Esperance Lake, Hewson, 234, 9.1963, (SYD); Lake Dobson, Mt. Mawson, Mt. Field National Park, Hewson, 237, 239A, 243, 245, 246, 247, 9.1963, (SYD); Russell Falls, Mt. Field National Park, Hewson, 253, 255, 256, 257, 258, 9.1963, (SYD); Silver Falls Track, Mt. Wellington, Hewson, 261, 9.1963, (SYD); Shoobridge Track, Mt. Wellington, Hewson, 268, 9.1963, (SYD); Organ Pipes Track, Mt. Wellington, Hewson, 270, 272, 9.1963 (SYD); Victoria: Steavenson Falls, Marysville, sine legit, sine no.. (MEL 14); NSW: Blackheath, Watts, 1053, 1.1911, (NSW); Adelina Falls, Lawson, Hewson, 25, 27, 3.1963; 120, 121, 122, 5.1963; 183, 184, 188, 8.1963; 290, 6.1964, (SYD); Mermaid's Glen, Blackheath, Hewson, 47, 58, 83, 87, 5.1963; 162, 8.1963; 312, 5.1964; 848, 7.1966, (SYD); Centennial Glen, Blackheath, Hewson, 88, 89, 93, 5.1963; 169, 8.1963, (SYD); Wentworth Falls, Hewson, 100, 102, 104, 5.1963, (SYD); Juncion Falls, Lawson, Hewson, 114, 115, 5.1963, (SYD); Minna Ha Ha Falls, Katoomba, Hewson, 181, 182, 8.1963, (SYD); Fitzroy Falls, Hewson, 196, 8.1963, (SYD); Snowy River nr. Charlotte Pass, Mt. Kosciusko, Hewson, 288, 1.1964, (SYD); Mt. Wilson, Hewson, 307, 5.1964; 325, 329, 6.1964, (SYD); Grand Canyon, Blackheath, Hewson, 317, 321, 322, 5.1964, (SYD); Somersby Falls, Hewson, 339, 7.1964, (SYD); Wragges Creek, Mt. Kosciusko, Na Thalang, 855, 1.1967, (SYD).

Discussion: Even though I have been unsuccessful in borrowing the Holotype of *R. reducta*, (S. slopes of Mt. Arrowsmith, Tasmania, Schuster, 50379a), I believe that it is a taxonomic synonym of *R. aequicellularis* for three reasons. Firstly, it fits within the extreme of variation observed for this species. Secondly, Schuster (1963, 1964) records *R. reducta* as having "oil bodies totally lacking". *R. aequicellularis* has been observed to have oil bodies lacking in approximately 75% of its thalli both within and between localities, so they are apparently rare. Thirdly, Schuster records gemmae as lacking, but since absence of gemmae in a specimen is not positive proof that they do not exist in the species as a whole, this can not be accepted as a positive character. Consequently, since *R. reducta* fits into the extreme variation of the external morphology of *R. aequicellularis*, absence of gemmae is not a positive character, and oil bodies are rare in *R. aequicellularis*, I am including it as a taxonomic synonym of *R. aequicellularis*.

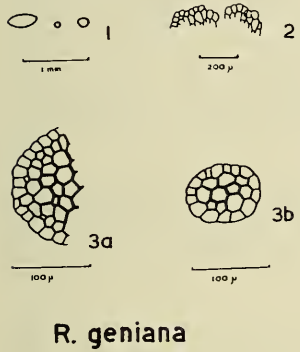
This action removes the basis for the subgenus *Phycancura* (of which *R. reducta* is the type species), because oil bodies are rare but not consistently lacking. The other reasons for the rejection of the subgenus are dealt with in "Mixed Data Numerical Analysis" section.

Distribution: New South Wales, Victoria, and Tasmania: 300–1,600 m.

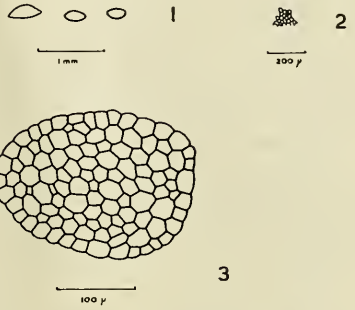
6. *Riccardia phlegantana* Hewson, sp. nov.

Dioica. *Thallus* parvus, (0·2) 0·5–0·8 (1·0) cm. longus, (0·3) 0·4–0·8 (1·0) mm. latus, plano- vel biconvexus, 3–5 cellulis crassitie, margine acuto, alato; ramificatio pinnata vel tripinnata; apices non dissecti; papillae mucilagineae, ventrales, persistentes in seriebus 2 regularibus ordinatis. *Cuticula* laevis. *Gemmae* apicales, ventrales et dorsales. *Corpora oleosa* 0–2 in quaque cellula 10 × 15–10 × 40 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 2–3 (4) cellula latitudine. *Rami plantarum femineorum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Caluptra* 1·5–2·5 (3·0) mm. longis 4–6 cellulis crassitie; cellulis pachydermatici dispersae et in umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 10–15 μ crassae. *Chromosomata gametophytica* 10.

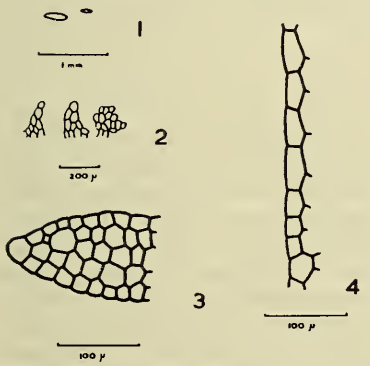
Dioecious. Plants on soil in exposed or disturbed places. *Thalli* (0·2) 0·5–0·8 (1·0) cm. long, (0·3) 0·4–0·8 (1·0) mm. wide, with an acute to winged margin, plano- to biconvex in transverse section, 3–5 cells thick; branching pinnate, bi- to tripinnate; apex not dissected, protected by ventral mucilage



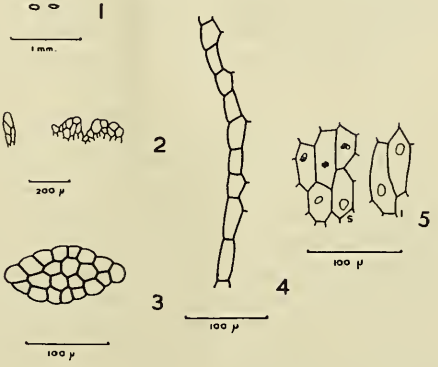
R. geniana



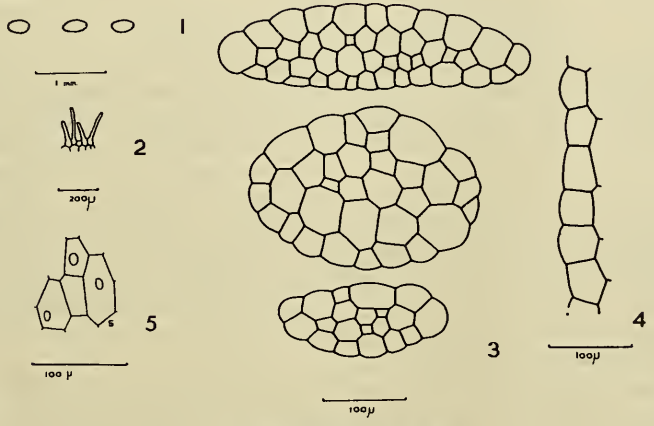
R. alcicornis



R. pindaundensis



R. ibana



R. aequicellularis

GP A

Fig. 6. 1. T. S. Thallus. 2. Paraphyses. 3. (a & b). T. S. Thallus for anatomy. 4. Margin in surface view. 5. Oil Bodies—S = in epidermal cells, I = in internal cells.

papillae which persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced in the dorsal and ventral apical regions. *Oil bodies* 2 per cell, 10 × 15–10 × 40 μ. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 7 per row; dorso-lateral wing 2–3 (4) cells wide. *Female plants* bearing archegonial branches lateral on main axis; archegonia in two rows; protected by multicellular, scalelike, and hairlike paraphyses. *Calyptra* 1·5–2·5 (3·0) mm. long at maturity; 4–6 cells thick; pachydermal cells scattered and in rough terminal umbo; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia phleganiana*—Holotype—Murigl River Valley near Omkali, Chimbu District, New Guinea, exposed on weathered limestone, Hewson, 546, 7.1965, (LAE): Isotypes (NSW. L). Named in honour of Phlegan who was a trainee Agricultural Officer and my first guide in the Chimbu District.

Specimens Examined: Murigl River Valley, Hewson, 551, 552, 553, 554, 557, 561, 562, 563, 7.1965, (SYD. LAE. L); Gembogl, Hewson, 565, 568, 572, 8.1965, (SYD. LAE. L); Tumbareri, Kagua, Hewson, 687, 8.1965, (SYD. LAE. L); Wakaru Range, Kagua, Hewson, 696, 8.1965, (SYD. LAE. L); Mungeri, Kagua, Hewson, 715, 719, 726, 727, 8.1965, (SYD. LAE. L); Edie Creek, 831, 9.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,200–2,500 m.

7. *Riccardia agumana* Hewson, sp. nov.

Dioica. Thallus parvus 0·5–1·0 cm. longus, 0·2–0·6 (0·8) mm. latus, plano-vel biconvexus, 3–4 cellulis crassitie, margine acuto, alato; ramificatio bi-(tri-) pinnata; apices non dissecti; papillae mucilagineae ventrales, persistentes in seriebus 2 regularibus ordinatis. *Cuticula* laevis. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 1–2 cellula latitudine. *Rami plantarum femineorum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 2–3 mm. longa, 4–7 cellulis crassitie; cellulis pachydermatici in fasciculi dispersae et in umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 10–15 μ crassae.

Dioecious. Plants mixed with other Bryophytes on soil, rotting logs, and in butts of grass in alpine florae. *Thalli* 0·5–1·0 cm. long, 0·2–0·6 (0·8) mm. wide, with acute, winged margins, plano- to biconvex in transverse section, 3–4 cells thick; branching bipinnate, rarely tripinnate; apex cleft but not dissected, protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced in the apical epidermal region. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 16 per row; dorso-lateral wing 1–2 cells wide. *Female plants* bearing archegonial branches latero-ventral to lateral on main axis and pinnae, not always of limited growth; archegonia in two rows, protected by multicellular, hairlike to fimbriate scalelike paraphyses. *Calyptra* 2–3 mm. long, 4–7 cells thick; pachydermal cells in scattered multicellular clusters and a rough terminal umbo; cuticle armate. *Seta* 4 cells in diameter. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosomes* unknown.

Typification: *Riccardia agumana*—Holotype—on soil in alpine grassland by the little lake at Brass Tarn, 3,800 m. Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 655, 8.1965, (NSW): Isotypes (LAE. L). Named in honour of Tomas Agum who was one of my guides on Mt. Wilhelm.

Specimens Examined: New Guinea: Lake Aunde, 3,500 m., Mt. Wilhelm, Hewson, 605, 617, 622, 634, 635, 8.1965, (SYD. LAE. L); 4,100 m., Mt. Wilhelm, Hewson, 643, 8.1965, (SYD. LAE. L); Brass Tarn, 3,800 m., Mt. Wilhelm, Hewson, 650, 651, 660, (SYD. LAE. L).

Distribution: New Guinea: 3,500–4,100 m.

8. and 9. *Riccardia bliklika* Hewson, sp. nov.

Monoica. Thallus pusillus, 4–10 mm. longus, 0·2–0·3 (0·5) mm. latus, plano- vel biconvexus, 3–4 cellulis crassitie, margine acuto, alato; ramificatio bi- vel tripinnata; apices non dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Gemmae* apicales. *Corpora oleosa* (0) 1–3 (4) in quaque cellula, 5 × 5–10 × 25–20 × 20 μ. *Rami masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 1–2 (3) cellula latitudine. *Rami feminearum* squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 0·5–1·5 mm. longa, 3–4 cellulis crassitie; cellulae pachydermatici dispersae et in umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 10–15 μ crassae. *Chromosomata gametophytica* 20.

Dioecious or monoecious. Plants tiny, prostrate or lateral on soil or wood in tropical coastal rainforest. *Thalli* 0·3–1·0 cm. long, 0·2–0·5 (0·6) mm. wide, with an acute, conspicuously winged margin and thus appearing to have a central nerve, plano- to bi-convex in transverse section, 3–4 cells thick; branching bi- to tripinnate; apex not dissected, protected by ventral non-persistent or persistent mucilage papillae; rhizoids ventral; basal stolons often present; cuticle smooth. *Gemmae* produced in epidermal cells in the apical region of some thalli. *Oil bodies* (0) 1–3 (4) per cell; 5 × 5–10 × 25–20 × 20 μ. *Male branches* lateral on main axis or pinnae, antheridia in two rows, up to 15 per row; dorso-lateral wing 1–2 (3) cells wide. *Female branches* latero-ventral on main axis or pinnae, often paroecious in monoecious forms, archegonia in two rows and produced last in acropetal succession in paroecious branches; paraphyses multicellular, scalelike. *Calyptra* 0·5–1·5 mm. long at maturity, 3–4 cells thick, pachydermal cells ± scattered and in a rough terminal umbo; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10, 20.

8. *Riccardia bliklika* var. *bliklika*

Monoecious. Thalli 0·3–1·0 cm. long, 0·2–0·3 (0·5) mm. wide; apex protected by ventral, non-persistent mucilage papillae. *Oil bodies* (0) 1–3 (4) per cell; 5 × 5–10 × 25–20 × 20 μ. *Male branches* with up to 4 (7) antheridia per row. *Calyptra* with pachydermal cells scattered and in rough terminal umbo. *Chromosome number*: n = 20.

Typification: *Riccardia bliklika*—Holotype—Vision Falls, Lake Eacham, Atherton Tableland, N. Qld., on weathering basalt in rainforest, Hewson, 387, 8.1964, (NSW): Isotype (BRI). Name derived from the Pidgin English words for small—"lik lik".

Specimens Examined: Queensland: Mossman Intake, Hewson, 364, 372, 8.1964, (SYD. BRI); Lake Eacham, Hewson, 399, 8.1964, (SYD. BRI); Tully Falls, Hewson, 402, 8.1964, (SYD. BRI); Diversion Dam, Hewson, 415, 8.1964, (SYD. BRI); Charmillan Creek, Hewson, 417, 423, 8.1964, (SYD. BRI); Souita Falls, Hewson, 435, 8.1964, (SYD. BRI); The Boulders, Hewson, 470, 8.1964, (SYD. BRI); Josephine Falls, Hewson, 475, 476, 8.1964, (SYD.

BRI); Crawford's Lookout, Hewson, 487, 492, 8.1964, (SYD. BRI); Paluma, Hewson, 506, 8.1964, (SYD. BRI); Jarrah Creek, Hewson, 514, 8.1964, (SYD. BRI); Eungella State National Park, Hewson, 518, 8.1964, (SYD. BRI).

9. *Riccardia bliklika* var. *porcina* Hewson var. nov.

Dioica. Thallus 0·3–1·0 cm. longus, (0·2) 0·3–0·5 (0·6) mm. latus; papillae mucilagineae persistentes in seriebus 2 regularibus ordinatis. *Rami plantarum masculinarum* cum vel 30 antheridia. Cellulae pachydermatici plus minusve dispersae et in umbone aspero terminales. *Chromosomata gametophytica* 10.

Dioecious. Thalli 0·3–1·0 cm. long, (0·2) 0·3–0·5 (0·6) mm. wide; apex protected by ventral mucilage papillae which tend to persist in two rows. *Oil bodies* unknown. *Male branches* with up to 15 antheridia per row. *Calyptra* with pachydermal cells ± scattered and in a rough terminal umbo. *Chromosome number*: n = 10.

Typification: *Riccardia bliklika* var. *porcina*—Holotype—on coconut husk, Pig Island, Madang, Madang District, New Guinea, Jacobs, 585, 8.1965, (NSW): Isotypes (LAE. L. SYD).

Specimens Examined: New Guinea: Madang Street, Madang, Jacobs, 586, 8.1965, (SYD. LAE. L); Bewapi Creek, nr. Lae, Hewson, 736, 8.1965, (SYD. LAE. L).

Distribution: New Guinea: sea level–300 m.

10. *Riccardia minima*

Riccardia minima Carrington and Pearson in Proc. Linn. Soc. NSW, 12: 1055 (1888); Schuster in J. Hatt. Bot. Lab., 26: 295 (1963).

Nomenclatural Synonym: *Aneura minima* (Carr. et Pears.) Stephani, "Sp. Hep.," 1: 229 (1899); sed non Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 65 (1917).

Dioecious. Plants in dense cushions or mixed with other Bryophytes on logs or on peaty or humus soil. *Thalli* (0·4) 0·5–1·0 (1·5) cm. long, 0·2–0·4 mm. wide, with acute winged margins, bi- to plano- to slightly concavo-convex in transverse section, 3–6 cells thick; branching bi- to tripinnate, (quadripinnate); apex not dissected; mucilage papillae lateral and ventral, persisting (i) ventral in two rows, and (ii) more rarely lateral at the margins; rhizoids not observed; cuticle smooth. *Gemmae* produced in dorsal apical region. *Oil bodies* unknown. *Male plants* bearing antheridial branches laterally as pinnae or pinnules; antheridia in two rows, up to 10 per row; dorso-lateral wing one cell wide. *Female plants* bearing archegonial branches latero-ventral, tending to be opposite on main axis and pinnae; paraphyses multicellular-hairlike and fimbriate-scalelike. *Calyptra* 1–1·5 (2) mm. long, 3–5 cells thick; pachydermal cells in a compact smooth terminal umbo; cuticle smooth. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 7–14 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia minima* Carr. et Pears.—Holotype—Coogee Bay, NSW, Whitelegge, 45, 5.1885, (MANCH Kk854): Isotype (NSW).

Specimens Examined: New South Wales: Neate's Glen, Blackheath, Hewson, 314B, 5.1964, (SYD); Tasmania: Lake Dobson, Mt. Field National Park, Hewson, 248A, 9.1963, (SYD).

Discussion: Rodway describes *Riccardia minima* as having a "ring of long pilose hairs" at the apex of the calyptra. Hence it is clear that his specimens should not have been referred to the species now under discussion.

Distribution: New South Wales, Tasmania: sea level–1,500 m.

11. *Riccardia babindae* Hewson, sp. nov.

Dioica. Thallus pusillus, 3–6 mm. longus, 0·2–0·4 mm. latus, plano- vel biconvexus, 3–4 cellulis crassitie, margine acuto, alato; ramificatio irregularibus, bi- vel quadripinnata; apices non dissecti; papillae mucilagineae, laterales, ramosae, persistentes. *Cuticula* laevis. *Corpora oleosa* in quaque cellula 1–2 (3); 3–10 × 6–40 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 1 cellula latitudine. *Rami plantarum feminearum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 0·5–1·5 mm. longa, 4–6 cellulis crassitie; cellulae pachydermatici dispersae. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 8–12 (15) μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants colonising rotten logs in rainforest. *Gametophyte* tiny, giving the log a velvety surface much as some algae do. *Thalli* 3–6 mm. long, 0·2–0·4 mm. wide with an acute to winged margin, plano- to biconvex in transverse section, 3–4 cells thick; branching irregularly bi- to quadripinnate; apex not dissected, protected by persistent lateral branched mucilage papillae; rhizoids usually ventral; basal stolons often present; cuticle smooth. *Gemmae* produced apically and marginally. *Oil bodies* 1–2 (3) per cell, often dimorphic in shape and in globule composition when more than one present; oval or circular, 6–10 × 6–25 μ, and coarse globular, and elongate, 3–6 × 20–40 μ, fine globular. *Male plants* bearing antheridial branches lateral on the main axis and pinnae, not always of limited growth, antheridia in two rows, up to 15 per row; dorso-lateral wing 1 cell wide with characteristic mucilage papillae. *Female* plants bearing archegonial branches lateral on main axis, not always of limited growth; archegonia in two rows, protected by multicellular, hairlike and fimbriate, scalelike paraphyses with characteristic mucilage papillae persisting on and between scales. *Calyptra* 0·5–1·5 mm. long at maturity, 4–6 cells thick; pachydermal ornamentation scattered, unicellular ± terminal clustering; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 8–12 (15) μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10, however there is some instability in the species; one specimen had n = 20.

Typification: *Riccardia babindae*—Holotype—The Boulders, Babinda, N. Qld., Hewson, 460, 8.1964, (NSW): Isotype (BRI).

Specimens Examined: North Queensland: Fishery Falls, Hewson, 453, 8.1964, (SYD. BRI); The Boulders, Babinda, Hewson, 468, 8.1964, (SYD. BRI); New Guinea: Blue Nose Point, Edie Creek, Hewson, 760, 8.1965, (SYD. LAE. L); Edie Creek, Hewson, 835, 8.1965, (SYD. LAE. L).

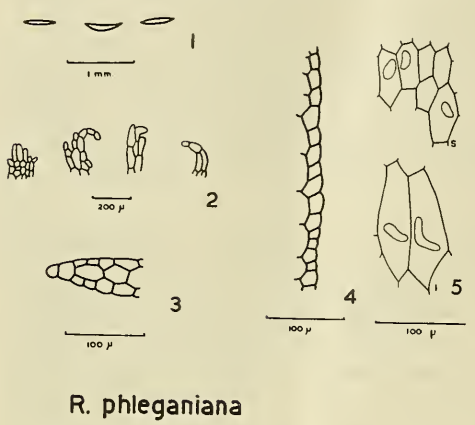
Distribution: North Queensland, New Guinea: 300–2,200 m.

Discussion: The mucilage papillae are unique in the Family. They are divided into 3 arms, one clasping dorsally, one ventrally, and the third lying parallel with the margin. These continue to persist along the margin of the thallus throughout its life.

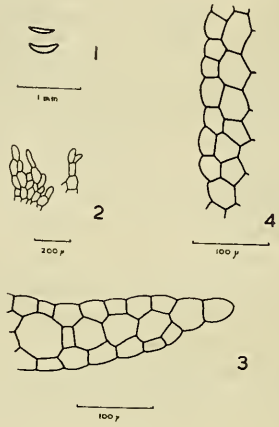
12. *Riccardia umbana* Hewson, sp. nov.

Monoica. Thallus parvus, 0·5–1·0 cm. longus, 0·5–1·0 mm. latus, concavo-convexus, 9–13 cellulis crassitie, margine acuto, alato; ramificatio bi- vel quadripinnata; apices dissecti; papillae mucilagineae ventrales, persistentes. *Cuticula* laevis. *Mycorrhiza* prodiens. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 3–4 cellula latitudine. *Rami plantarum feminearum* squamis multicellularibus, archegonia cingentibus instructi. *Calyptra* 0·5–1·5 mm. longa, 4–8 cellulis crassitie; cellulis pachydermatici in fasciculi dispersae. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 15–20 μ crassae, papillatae.

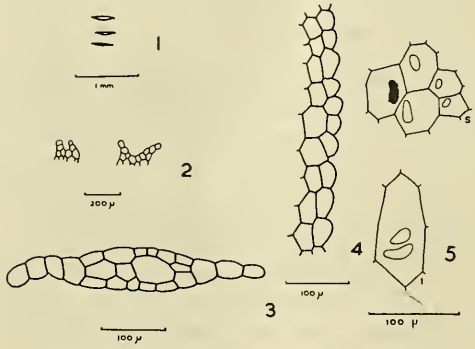
Monoecious. Plants growing in bases of mosses in alpine grassland. *Thalli* 0·5–1 cm. long, 0·5–1 mm. wide with an acute winged margin, wing 3–4 (5) cells wide, cells thick walled, concave-convex in transverse section, 9–13 cells thick; ventral epidermal cell walls tend to be thickened; branching bi- to



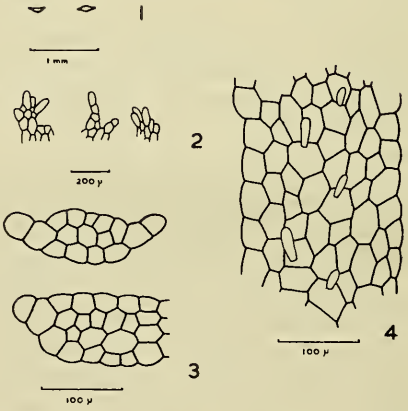
R. phleganiana



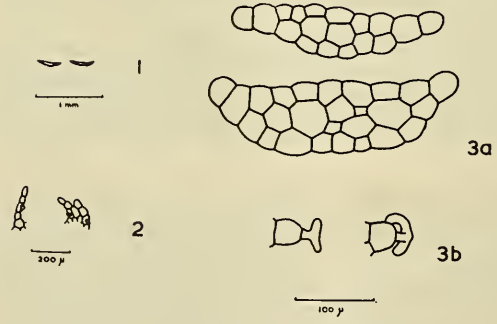
R. agumana

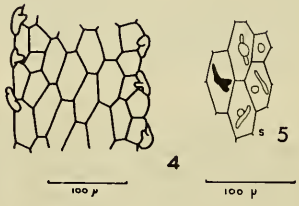


R. bliklika



R. minima





R. babindae

GP **B**

Fig. 7. 1. T. S. Thallus. 2. Paraphyses. 3. (*a*) T. S. Thallus for anatomy, (*b*) mucilage papillae. 4. Margin or thallus in surface view. (Ventral—*R. minima*). 5. Oil Bodies—S = in epidermal cells, I = in internal cells.

quadripinnate; apex deeply dissected and protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced in the dorsal epidermal cells. *Mycorrhiza* present throughout the internal cells though not in all cells. *Oil bodies* unknown. *Male branches* lateral on main axis, pinnae (and pinnules), not always of limited growth; antheridia in two rows, up to 10 per row; dorso-lateral wing 3–4 cells wide. *Female branches* lateral on main axis and pinnae; archegonia in two rows, protected by multicellular, scalelike paraphyses. *Calyptra* 0·5–1·5 mm. long, 4–8 cells thick; pachydermal cells in scattered multicellular clusters; cuticle smooth. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 15–20 μ in diameter, papillate. *Chromosomes* unknown.

Typification: *Riccardia umbana*—Holotype—mixed at bases of moss on rotten log, 3,700 m., Lake Pinde, Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 614, 8.1965, (N.S.W.): Isotypes (LAE. L). Named in honour of Umba who was one of my guides on Mt. Wilhelm.

Distribution: New Guinea: 3,700 m.

13. *Riccardia tumbarerieusis* Hewson, sp. nov.

Dioica. Thallus medius, 0·5–1·0 (2·0) cm. longus, 0·5–1·0 (1·5) mm. latus, concavo-convexus, 7–12 cellulis crassitie, margine acuto; ramificatio pinnata vel tripinnata; apices dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Mycorrhiza* prodiens. *Rami plantarum masculinarum* laterales; antheridia in seriesbus 2 regularibus ordinatis; alae 1–2 cellula latitudine. *Rami plantarum feminearum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 1–2 mm. longa, 5–8 cellulis crassitie; cellulae pachydermatici in fasciculi dispersae. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 10–15 μ crassae.

Dioecious. Plants prostrate on soil, often sunken into substrate. *Thalli* 0·5–1·0 (2·0) cm. long, 0·5–1·0 (1·5) mm. wide, with acute margins, marginal cells ± thickened; deeply concave-convex in transverse section so that margins tend to be closely appressed, 7–12 cells thick; branching pinnate to tripinnate; apex deeply dissected, protected by ventral non-persistent mucilage papillae; rhizoids ventral; cuticle smooth. *Gemmae* produced in dorsal apical epidermal cells. *Mycorrhiza* present in ventral internal cells. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 6 per row; dorso-lateral wing 1–2 cells wide. *Female plants* bearing archegonial branches latero-ventral on main axis; paraphyses multicellular, hairlike and scalelike, tending to be club-shaped. *Calyptra* 1–2 mm. long, 5–8 cells thick; pachydermal cells in multi-cellular clusters giving capsule a shaggy appearance; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosomes* unknown.

Typification: *Riccardia tumbarerieusis*—Holotype—on soil, 1,700 m., Tumbareri Village, Kagua, Southern Highlands District, New Guinea, Hewson, 688, 8.1965, (NSW): Isotypes (LAE. L).

Specimens Examined: 2,150 m., Meri Creek, Edie Creek, New Guinea, Hewson, 747, 8.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,700–2,200 m.

14. *Riccardia pindensis* Hewson, sp. nov.

Dioica. Thallus magnitudine mediocri, 0·5–1·0 cm. longus, (0·6) 1·0–1·5 (2·0) mm. latus, concavo- vel planoconvexus, 5–8 cellulis crassitie, margine

obtuso vel acuto; ramificatio pinnata vel bipinnata (tripinnata); apices dissecti sed lati; papillae mucilagineae ventrales, conspicuae, non-persistentes. *Cuticula* laevis. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinata; alae 1–2 cellulis latitudine. *Rami plantarum femineorum* squamis multicellularibus, reductis, archegonia cingentibus, instructi. *Calyptra* 1–2 mm. longa, 5–7 cellulis crassitie; cellulae pachydermaticae in fasciculi. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (i) similis. *Sporae* 14–22 μ crassae, papillatae. *Chromosomata gametophytica* ? 10.

Dioecious. Plants in mats on damp to wet soil in alpine grassland. *Thallus* 0·5–1·0 cm. long, (0·6) 1·0–1·5 (2·0) mm. wide, with an obtuse to acute margin, marginal cell walls tending to be thickened, concave to plano-convex in transverse section, 5–8 cells thick; ventral epidermal cell walls tending to be thickened; branching pinnate to bipinnate (tripinnate); apices dissected but apical region broad; mucilage papillae ventral, conspicuous, not persistent; mucilage conspicuous; rhizoids ventral; cuticle smooth. *Gemmae* not observed. *Mycorrhiza* present throughout ventral epidermal cells and internal cells (but not in all internal cells). *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on main axis and pinnae, 3–4 branches often rising together; antheridia in two rows, up to 10 per row; dorso-lateral wing 1–2 cells wide. *Female plants* bearing archegonial branches latero-ventral to lateral on main axis and pinnae; archegonia in 2 rows, protected by reduced, multicellular, scalelike paraphyses. *Calyptra* 1–2 mm. long, 5–7 cells thick, pachydermal cells in scattered elongate, multicellular projections; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (i). *Spores* 14–22 μ in diameter, papillate. *Chromosome number*: ? n = 10.

Typification: *Riccardia pindensis*—Holotype—on soil in running water in gully running into West side of Lake Pinde, 3,650 m., Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 600, 8.1965, (NSW): Isotype (LAE. L).

Specimen Examined: 3,650 m., Lake Pinde, Mt. Wilhelm, New Guinea, Hewson, 624, 8.1965, (SYD. LAE. L).

Distribution: New Guinea: 3,600–3,700 m.

15. *Riccardia longiflora* (Stephani) Hewson comb. nov.

Nomenclatural Synonym: *Aneura longiflora* Steph., "Sp. Hep.," 1: 256 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 62 (1917).

Dioecious. Thalli 1–2 cm. long, 1–1·5 (2) mm. wide, with an acute to winged margin, wing cells often slightly thickened, however this is not as distinctive and regular as in *R. cochleata* (Hook. f. et Tayl.) Kuntze; plano- to deeply concave-convex in transverse section, 6–10 cells thick; branching pinnate to tripinnate; apex deeply dissected and protected by ventral non-persistent mucilage papillae; clumps of superficial cells (1–4 together) are often present on the ventral and dorsal surface of the thallus near the apex; rhizoids ventral; cuticle smooth. *Gemmae* produced both dorsally and ventrally in the apical region. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on thallus; antheridia in two rows, up to 6 per row; dorso-lateral wing one cell wide. *Female plants* bearing short latero-ventral archegonial branches; paraphyses multicellular, fimbriate, scalelike. *Calyptra* up to 8 mm. long, 5–7 cells thick; pachydermal cells scattered and in a rough terminal cluster; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule* and *chromosomes* unknown.

Typification: *Aneura longiflora* Steph.—Holotype—Bower Crk., Mt. Wellington, Tasmania, Weymouth, sine no., 12.1897, (G 938 ex Hb. Levier 970).

Specimens Examined: Tasmania: 600 m., Mt. Wellington, sine leg., sine no., 10, 1913, (HO ex Hb. Rodway); Mt. Hartz track, sine leg., sine no., 12.1914, (HO 19 ex Hb. Rodway).

Discussion: Rodway describes this species as being very variable, but much of this variation was due to incorrect identification. His *Aneura longiflora* Steph. f. *submersa* Rodway, is in fact, *Riccardia crassa* (Schwägr.) Carr. et Pears.

Distribution: Tasmania: 300–900 m.

16. *Riccardia cochleata*

Riccardia cochleata (Hook. f. et Tayl.) Kuntze in Revisio "Generum Plantarum:" Hepaticae, 829 (1891); Schuster in *J. Hatt. Bot. Lab.*, 26: 294 (1963); Schuster in *J. Hatt. Bot. Lab.*, 27: 213–3 (1964).

Nomenclatural Synonyms: *Riccia? cochleata* Hook. f. et. Tayl. in *Lond. J. of Bot.*, 4: 96 (1845); Hook. f. et Tayl. in Hook. f., "The Botany of The Antarctic Voyage, Flora Antarctica," I, 2: 168 (1847). *Sarcomitrium cochleatum* (Hook. f. et Tayl.) Mitten in Hook. f., "The Botany of the Antarctic Voyage, Flora Tasmaniae," III, 2: 240 (1860); Bastow in *P. & Proc. Roy. Soc. Tas.*, 1887: 278 (1888). *Aneura cochleata* (Hook. f. et Tayl.) Hook. f. in "Handbook of the New Zealand Flora," 543 (1867); Stephani in *Hedwigia*, 32: 137 (1893); Stephani, "Sp. Hep.," 1: 270 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 64 (1917).

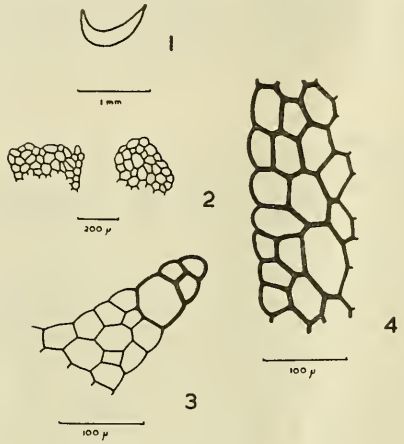
Taxonomic Synonyms: *Aneura erecta* Stephani, "Sp. Hep.," 1: 268 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 64 (1917). *Aneura lichenoides* Stephani," Sp. Hep.," 6: 32 (1917), sed non *Aneura lichenoides* Stephani in *Bot. Jahrb.*, 23: 301 (1896).

Dioecious. *Plants* growing in cushions in wet regions on soil or wood (rarely on rock), usually mixed with other Bryophytes, especially members of the family Lepidoziaceae. The plants are very crisp so that the cushion is brittle and harsh to touch, and they have a characteristic odour not unlike the odour of foxes. *Thalli* 0·5–1·5 (2·0) cm. long, (1·0) 1·5–3 (4·0) mm. wide, with acute to winged margin, marginal cells have very thick walls giving the thallus a characteristic border which is white in herbarium material, plano- to deeply concave-convex in transverse section, the concavity is often accentuated to spoon-like immediately behind apices, (5) 7–10 (12) cells thick; branching pinnate with bipinnate lobing; apex deeply dissected, protected by ventral non-persistent mucilage papillae; rhizoids not observed; stolons usually present; cuticle smooth. *Gemmae* produced in profusion in the cup-shaped region behind the apex. *Oil bodies* 1–2 per cell, globular, (6) 8–12 (13) μ in the epidermal cells and (8) 15–20 (24) μ in the internal cells. *Male plants* bearing antheridial branches lateral on thallus, singly or up to 3 together; antheridia in two rows, up to 8 per row; dorso-lateral wing 1 (2) cells wide, resembling vegetative marginal cells. *Female plants* bearing archegonial branches latero-ventrally; archegonia often in more than one group as though 2–3 branches arise together; paraphyses multicellular, fimbriate, scalelike. *Calyptra* 2–4 mm. long, 4–8 cells thick; pachydermal armation multicellular, thick walled and pigmented; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–14 (15) μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10, however one record from Tasmania has n = 20.

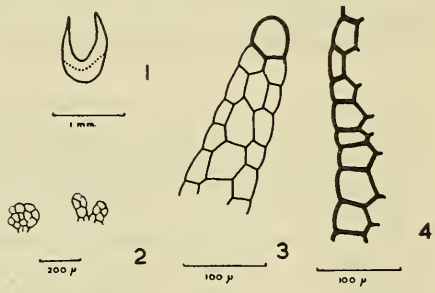
Typification: *Riccia ? cochleata* Hook. f. et Tayl.—Holotype—Lord Aucklands Island, D. Hooker, sine no., (NY ex Hb. Mitten). *Aneura erecta* Steph.—Holotype—Deep Creek, Mt. Wellington, Tasmania, Weymouth, 915, 12.1887, (G 11038 ex Hb. Levier). *Aneura lichenoides* Steph.—Holotype—

Dubbilbarril, King River, Tasmania, Weymouth, 991, 12.1899, (G 11044 ex Hb. Levier 5182).

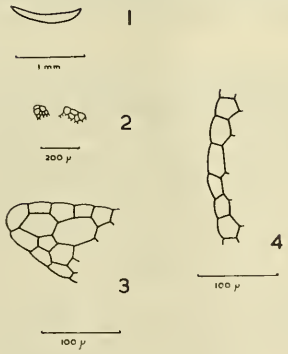
Specimens Examined: Tasmania: St. Patrick's River, sine leg. 1769, 10.1845, (NY ex Hb. Mitten); The Falls, Mt. Archer, sine No., 1882, (NY



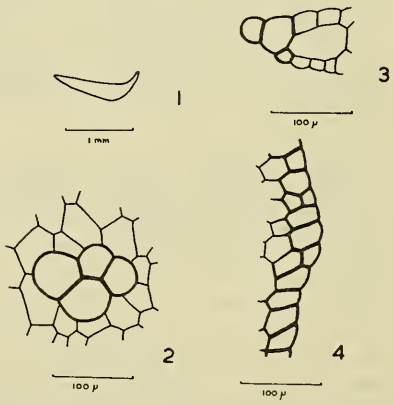
R. umbana



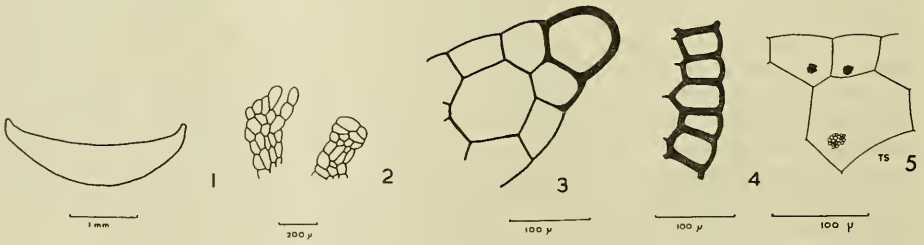
R. tumbarerensis



R. pindensis



R. longiflora



R. cochleata

GP C

Fig. 8. 1. T. S. Thallus. 2. Paraphyses. (Superficial cells on thallus surface in *R. longiflora*.) 3. T. S. Thallus margin for anatomy. 4. Margin in surface view. 5. Oil bodies.

ex Hb. Mitten) ; Lake Dobson, Mt. Mawson, Mt. Field National Park, Hewson, 238, 9.1963, (SYD) ; Reid's Track, Mt. Wellington, Hewson, 263, 9.1963, (SYD) ; Shoobridge Track, Mt. Wellington, Hewson, 267, 9.1963, (SYD) ; Pipe Line Track, Mt. Wellington, Hewson, 274, 277, 9.1963, (SYD) ; NSW: Illawarra, Kirton, sine no., 1882, (NY ex Hb. Mitten) ; Neate's Glen, Blackheath, Hewson, 51, 59, 86, 87, 5.1963, 163, 8.1963, 311, 5.1964, 521, 10.1964, 849, 5.1966, (SYD) ; Grand Canyon, Blue Mts., Hewson, 319, 5.1964, (SYD).

Distribution: New South Wales, Tasmania, and New Zealand: 300–1,500 m.

17. *Riccardia wattsiana* (Stephani) Hewson, comb. nov.

Nomenclatural Synonym: *Aneura wattsiana* Stephani, in "Sp. Hep.," 6: 46 (1917).

Misapplied Name: *Aneura marginata* (non Col.) Stephani, "Sp. Hep.," 1: 259 (1899).

Monoecious. *Plants* prostrate lateral or ventral on rock, soil, or wood in a range of habitats including wet sclerophyll forest in Southern Australia and tropical rainforest in New Guinea. *Thalli* 0·5–2·0 (3·0) cm. long, 0·5–1·5 mm. wide, with an acute, winged margin, plano- to biconvex in transverse section, 3–6 cells thick; branching bi- to tripinnate; apex dissected and protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral or dorsal; basal stolons often present; cuticle smooth. *Gemmae* often produced in profusion in the apical region. *Oil bodies* (0) 1–10 (15) per cell, 3 × 3–25 × 30 μ (15 × 45 μ when elongate in internal cells). *Male branches* usually produced first, lateral on main axis or pinnae; antheridia in two rows up to 7 per row; dorso-lateral wing 1–4 cells wide (widest when paroecious). *Female branches* usually produced secondarily to the male branches with paroecious intermediates, lateral on main axis or pinnae; archegonia in two rows (youngest in acropetal succession in paroecious branches) ; paraphyses variable multicellular, fimbriate hairlike to scalelike. *Calyptra* 2–4 (5) mm. long at maturity; 4–6 cells thick; pachydermal cells scattered and in a loose terminal cluster; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 9–14 μ minutely sculptured, scabrate. *Chromosome number*: n = 20.

Typification: *Aneura wattsiana* Steph.—Holotype—Ballina, NSW, Watts, 237, 3.1901, (G 11057 ex Hb. Levier 3018) : Isotype (NSW 237).

Specimens Examined: Western Australia: Giant's Cave, Augusta, Howlett, 289, 4.1960, (Uni. WA. MEL 66W) ; Tasmania: Pipe Line Track, Mt. Wellington, Hewson, 279, 282, 9.1963, (SYD) ; NSW: Captain's Flat, Connell, 335, 336, 7.1964, (SYD) ; Neate's Glen, Blackheath, Hewson, 65, 73, 5.1963, 173, 8.1963, 313, 314, 314A, 315, 5.1964, (SYD) ; Happy Valley Creek, Mt. Wilson, Hewson, 306, 5.1964, 326, 327, 6.1964, (SYD) ; Rodriguez Pass, Blackheath, Hewson, 324, 5.1964, (SYD) ; Lord Howe Island, McWilliam, 334, 6.1964, (SYD) ; Queensland: Stradbroke Island, Jacobs, 332, 6.1964, (SYD) ; Mt. Bartle Frere, Flecker, 11.1936, (MEL) ; Daintree River, Pentzke, 1886, (MEL) ; Murray Falls, Hewson, 343, 345, 348, 350, 8.1964, (SYD. BRI) ; Mossman River, Hewson, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 363, 8.1964, (SYD. BRI) ; Mossman Intake, Hewson, 365, 366, 368, 369, 371, 372, 373, 375, 376, 377, 379, 382, 8.1964, (SYD. BRI) ; Lake Eacham, Hewson, 383, 384, 386, 390, 391, 392, 394, 397, 399, (SYD. BRI) ; Tully Falls, Hewson, 404, 408, 410, 413, 8.1964, (SYD. BRI) ; Diversion Dam, Hewson, 414, 416, 8.1964, (SYD. BRI) ; Charmillan Creek, Hewson, 420, 421, 424, 8.1964, (SYD. BRI) ; Elinjaa Falls, Hewson, 432, 433, 8.1964, (SYD. BRI) ; Millaa Millaa Falls, Hewson, 428, 429, 8.1964, (SYD. BRI) ; Souita Falls, Hewson, 434, 436,

437, 438, 439, 442, 8.1964, (SYD. BRI); Mt. Hypipamee, Hewson, 443, 444, 445, 449, 8.1964, (SYD. BRI); Lake Barrine, Hewson, 450, 451, 452, 8.1964, (SYD. BRI); Fishery Falls, Hewson, 454, 455, 456, 457, 458, 459, 8.1964, (SYD. BRI); The Boulders, Hewson, 461, 462, 463, 464, 465, 466, 467, 468, 469, 471, 472, 473, 8.1964, (SYD. BRI); Josephine Falls, Hewson, 476, 477, 478, 479, 480, 8.1964, (SYD. BRI); Wallacha Falls, Hewson, 481, 482, 483, 8.1964, (SYD. BRI); Tchupalla Falls, Hewson, 484, 485, 486, 8.1964, (SYD. BRI); Crawford's Lookout, Hewson, 488, 489, 490, 491, 493, 494, 495, 496, 8.1964, (SYD. BRI); Nandroya Falls, Hewson, 497, 499, 501, 502, 503, 504, 505, 8.1964, (SYD. BRI); Jarrah Creek, Hewson, 507, 510, 511, 512, 513, 8.1964, (SYD. BRI); Eungella State National Park, Hewson, 516, 517, 9.1964, (SYD. BRI); New Guinea: Rouna Falls, Hewson, 538, 539, 540, 541, 542, 543, 544, 545 7.1965 (SYD. L. LAE); Murigl River, Hewson, 555, 559, 7.1965, (SYD. L. LAE); Gembogl, Hewson, 571, 8.1965, (SYD. L. LAE); Bewapi Creek, Bewapi, Hewson, 731, 732, 733, 734, 737, 742, 745, 8.1965, (SYD. L. LAE); Meri Creek, Edie Creek, Hewson, 749, 8.1965, (SYD. L. LAE).

Distribution: New Guinea, Queensland, New South Wales, Tasmania, Western Australia: sea level–2,500 m.

18. *Riccardia argento-limbata*

Riccardia argento-limbata Hewson et Grolle in *J. Hatt. Bot. Lab.*, 29: 70 (1966).

Dioecious. Plants in loose mats on humus soil, or creeping between other Bryophytes (including *Riccardia* spp.), or grass in alpine forest, or grassland. *Thalli* up to 6 cm. long, 1–3 mm. wide, ribbon-like, with acute, ± winged, characteristic margins; marginal row of cells without pigment (white in herbarium specimens), elongate, up to 300 μ long, usually angled towards the axis of growth between 30° to 90°. Plano-convex to concave-convex in transverse section, 4–6 cells thick; branching pinnate; lobing pinnate to bipinnate; apex not dissected, protected by ventral mucilage papillae which appear to be produced behind a broad apical region and tend to persist especially latero-ventrally, conspicuous, mucilage conspicuous even to naked eye in the field; rhizoids ventral; cuticle smooth. *Gemmae* produced in the dorsal epidermal cells towards the apex. *Oil bodies* 1–6 per cell, 8 × 8–15 × 20–15 × 35 μ. *Male plants* bearing antheridial branches laterally at lobes on main axis and pinnae, recurved, up to three arise together; antheridia in two rows, up to 12 per row; dorso-lateral wing 1–2 cells wide, marginal row similar to vegetative margin but tends to be dentate. *Female plants* bearing archegonial branches latero-ventral beneath the lobes on the main axis and pinnae; paraphyses multicellular, scalelike. *Calyptra* up to 4 mm. long, 7–12 cells thick: pachydermal cells scattered in loose multicellular clusters and in a rough terminal umbo, cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* unknown. *Chromosome number*: ? n = 10.

Typification: *Riccardia argento-limbata* Hewson et Grolle—Isotype—mountain rain forest, E. slopes of Mt. Hagen, 2,600 m., Western Highlands District, New Guinea, Robbins, 215/H-b, (JE. CANB), Holotype at B and Isotypes at CANB and NICH not seen by me; Paratype—among grass in overhang near gully on way to Brass Tarn from Air Crash, 3,000 m., Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 645, 8.1965, (JE. NSW. SYD. LAE. L).

Specimens Examined: New Guinea: 2,900 m., Pindaunde Valley, Mt. Wilhelm, Hewson, 588, 8.1965, (SYD. LAE. L); 3,650 m., Lake Pinde, Mt. Wilhelm, Hewson, 594, 596, 604, 613, 619, 620, 8.1965, (SYD. LAE. L);

3,800 m., nr. Brass Tarn, Mt. Wilhelm, Hewson, 644, 659, 8.1965, (SYD. LAE. L); 2,150 m., Track to Bulldog Rd., Edie Creek, Hewson, 833, 837, 9.1965, (SYD. LAE. L).

Distribution: New Guinea: 2,100–3,800 m.

19. *Riccardia macdonaldiana* Hewson, sp. nov.

Dioica. Thallus parvus, 1–2 (3) cm. longus, (0·3) 0·5–0·8 (1·0) mm. latus, plano- vel biconvexus, 4–6 cellulis crassitie, margine acuto, alato; ramificatio bi- vel tripinnata, apices non dissecti; papillae mucilagineae ventrales, persistentes in seriebus 2 regularibus ordinatis. *Cuticula* laevis. *Gemmae* apicales. *Corpora oleosa* 0–3 (4) in quaque cellula, 5 × 8–15 × 20–10 × 40 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 0–1 cellula latitudine. *Rami plantarum feminearum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 1·5–2·5 mm. longa, 5–7 cellulis crassitie; cellulis pachydermatici dispersae et in umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iv) similis. *Sporae* 10–15 μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants on soil or wood in rainforest. *Thalli* 1–2 (3) cm. long, (0·3) 0·5–0·8 (1·0) mm. wide, with acute and usually winged margin; plano- to biconvex in transverse section, 4–6 cells thick; branching bi- to tripinnate; apex not dissected and protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced in apical epidermal region. *Oil bodies* 0–3 (4) per cell, 5 × 8–15 × 20–10 × 40 μ. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 25 per row; dorso-lateral wing 0–1 cell wide. *Female plants* bearing archegonial branches lateral on main axis and pinnae; archegonia in two rows, presented laterally or dorsally, protected by multicellular, hairlike and scalelike paraphyses. *Calyptra* 1·5–2·5 mm. long at maturity, 5–7 cells thick; pachydermal cells scattered and in a loose terminal cluster; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia macdonaldiana*—Holotype—Mossman Gorge, 3/4 mile beyond Mossman Mission, on soil and roots in rainforest. Hewson, 326, 8.1964, (NSW): Isotype (BRI). Named in honour of Mr. A. Macdonald who greatly assisted with collection while in North Queensland.

Specimens Examined: North Queensland: Murray Falls, Hewson, 349, 8.1964, (SYD. BRI); Mossman River Intake, Hewson, 357, 366, 372, 378, 379, 380, 381, 8.1964, (SYD. BRI); Lake Eacham, Hewson, 385, 390, 395, 399, 8.1964 (SYD. BRI); Tully Falls, Hewson, 403, 409, 411, 8.1964, (SYD. BRI); Charmillan Creek, Hewson, 419, 8.1964. (SYD. BRI); Millaa Millaa Falls, Hewson, 426, 427, 430, 431, 8.1964, (SYD. BRI); Josephine Falls, Hewson, 475, 8.1964, (SYD. BRI); Crawford's Lookout, Hewson, 492, 8.1964, (SYD. BRI); Nandroya Falls, Hewson, 498, 8.1964, (SYD. BRI); Jarrah Creek, Hewson, 515, 8.1964, (SYD. BRI).

Distribution: North Queensland: 300–900 m.

20. *Riccardia bipinnatifida* (Col.), Hewson, comb. nov.

Nomenclatural Synonym: *Aneura bipinnatifida* Col., in *Trans. Proc. NZ Inst.*, 16: 358 (1884).

Taxonomic Synonym: *Aneura polymorpha* Col., *Trans. Proc. NZ Inst.*, 22: 457 (1890); Stephani, "Sp. Hep.," 1: 256 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 63 (1917).

Dioecious. Plants loosely with other Bryophytes, or in dense mats, on rock, soil, or wood, in damp conditions to submerged in swiftly running water. *Thalli* 1–3 cm. long, 1–1·5 mm. wide, with an acute, rarely winged margin, plano- to biconvex in transverse section, 4–8 cells thick; bi- to tripinnate branching; apex dissected, and protected by ventral mucilage papillae which tend to persist in some specimens; rhizoids ventral; cuticle smooth. *Gemmae* often produced in profusion in the apical epidermal cells. *Oil bodies* (0) 1–3 (4) per cell (more frequent in epidermal cells than in internal cells), 5 × 5–15 × 20 μ. *Male plants* bearing antheridia in two rows, up to 7 in each row; dorso-lateral wing 1–2 cells wide. *Female plants* bearing archegonia on lateral branches, often reverting to vegetative growth; archegonia in two rows, protected by multicellular, slightly fimbriate, scalelike paraphyses. *Calyptra* 2–3 mm. long at maturity, 5–7 cells thick; pachydermal cells scattered and in a loose terminal cluster; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Aneura bipinnatifida* Col. — Holotype — New Zealand, Colenso, a.2018, (G 12614 ex K): Isotype, (Hodgson 2018 ex K). *Aneura polymorpha* Col.—Holotype—New Zealand, Colenso, a.936, (K 936): Isotypes, (G 11048 ex K pro parte. Hodgson 936 ex K ex parte).

Specimens Examined: Tasmania: Mt. Hartz National Park, Hewson, 221, 9.1963, (SYD); Silver Falls Track, Mt. Wellington, Hewson, 260, 9.1963, (SYD); Victoria: Otway Ranges between Apollo Bay & Glen Aire, Williams, 923, 8.1960, (MEL); Tarra Valley National Park, Yarram, Healey, 42, 2.1960, 77, 1961 (MEL); E. of Tangil River, Mt. Baw Baw, Willis, 3.1951, (MEL); NSW: Barrington Tops, Hewson, 137, 6.1963, (SYD); Flat Rock Creek, North Shore, Sydney, Hewson, 139, 6.1963, (SYD); Cambewarra Mountain, Hewson, 202, 203, 204, 8.1963, (SYD); Charlotte Pass, Mt. Kosciusko, Hewson, 289, 1.1964, (SYD); Mt. Wilson, Hewson, 305, 4.1964, 310, 5.1964, (SYD); Captain's Flat, Connell, 337, 7.1964, (SYD); Queensland: Bunya Mountains, Hewson, 519, 9.1964, (SYD, BRI).

Discussion: The Holotype for *R. bipinnatifida* is no longer housed in Kew, but is at Geneva. The Holotype for *R. polymorpha* is still housed at Kew. There seems no doubt that these are synonymous, but since *R. polymorpha* is a later homonym it is therefore illegitimate. The isotype at Geneva of *R. polymorpha* is somewhat confusing since it is composed of two discordant elements. These are *R. bipinnatifida* and *R. crassa*. It is unfortunate that Mrs. Hodgson's isotype (ex Kew) seems to consist only of *R. crassa*.

Distribution: Queensland, New South Wales, Victoria, Tasmania, and New Zealand: sea level–1,500 m.

21. *Riccardia loriana*

Riccardia loriana (Steph.) H. A. Miller in *Ark. J. Bot.*, 5: 528 (1963).

Nomenclatural Synonym: *Aneura loriana* Steph., "Sp. Hep.," 1: 243 (1899).

Dioecious. Plants very variable in form, growing on rotten logs or on humus soil in alpine or sub-alpine regions. *Thalli* 0·5–1·0 (1·5) cm. long, (0·3) 0·5–1·0 (2·0) mm. wide, with acute usually winged margin, plano- to biconvex in transverse section, (3) 4–7 cells thick; branching bipinnate often appearing palmate; apex dissected, protected by ventral non-persistent mucilage papillae; rhizoids ventral; cuticle smooth. *Gemmae* not observed. *Oil bodies* 0–1 per cell, 10 × 10–25 × 35 μ. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 10 per row; dorso-lateral wing 2–4 cells wide, often dentate. *Female plants* bearing

archegonial branches latero-ventral on main axis and pinnae; archegonia in two rows, protected by multicellular, fimbriate, scalelike paraphyses. *Calyptra* 2–3 mm. long, 7–10 cells thick; pachydermal cells ± scattered and in terminal umbo; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 10–15 μ, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Aneura loriana* Steph.—Holotype—Mt. Moroka, 1,300 m., Moresby, New Guinea, Loria, 112, 1893, (G 12118 ex Hb. Levier).

Specimens Examined: New Guinea: Pindaunde Moss Forest, 2,900 m., Mt. Wilhelm, Hewson, 589, 592, 593, 8.1965, (SYD. LAE. L); Lake Aunde, 3,500 m., Mt. Wilhelm, Hewson, 622, 628, 631, 635, 8.1965, (SYD. LAE. L); Enduakambugo, 4,600 m., Mt. Wilhelm, Hewson, 638, 8.1965, (SYD. LAE. L); Pengage Valley, 2,700 m., Mt. Wilhelm, Hewson, 699, 8.1965, (SYD. LAE. L); Marafunga, Hewson, 684, 685, 8.1965, (SYD. LAE. L); Wakaru Range, Kagua, Hewson, 691, 694, 700, 702, 8.1965 (SYD. LAE L); Meri Creek, Edie Creek, Hewson, 750, 751, 8.1965, (SYD. LAE L); Blue Nose Point, Edie Creek, Hewson, 757, 8.1965 (SYD. LAE. L); Mt. Kaindi, Edie Creek, Hewson, 790, 793, 796, 811, 814, 8.1965, (SYD. LAE. L); Edie Creek, Hewson, 821, 829, 8.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,200–4,600 m.

22. *Riccardia tenella* Hewson, sp. nov.

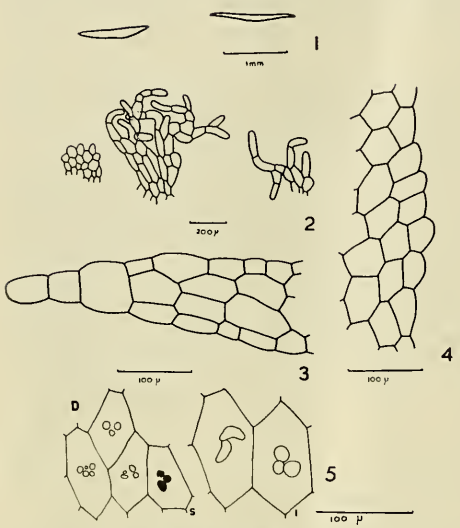
Dioica. Thallus parvus, 1–2 cm. longus, 0·2–1·0 mm. latus, cylindratus vel plano-convexus, 5–9 cellulis crassitie; margine obtuso vel acuto vel alato; ramificatio bi- vel tripinnata; apices non dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2, regularibus ordinatis; alae 1–2 cellula latitudine. *Rami plantarum femineārum* squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 1·5–3 mm. longa, 4–7 cellulis crassitie; cellulis pachydermatici plus minusve dispersi et umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardia* (iv) similis. *Sporae* 10–15 μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants on humus soil or rotting logs in rainforest. *Thalli* tend to be polymorphic within and between plants, 1–2 cm. long, 0·2–1·0 mm. wide, margins obtuse, or acute, or winged, or winged from a narrow nerve; circular to plano-convex in transverse section, 5–9 cells thick; prostrate main axis with pinnate to bipinnate erect branches; apex rounded to slightly cleft, protected by ventral, non persistent mucilage papillae; rhizoids ventral; cuticle smooth. *Gemmae* produced in profusion around the apex. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 16 per row; dorso-lateral wing 1–3 cells wide. *Female plants* bearing archegonial branches latero-ventral to lateral on main axis and pinnae, archegonia in two rows, protected by multicellular, scalelike paraphyses. *Calyptra* 1·5–3 mm. long, 4–7 cells thick; pachydermal cells ± scattered, and in rough terminal umbo; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

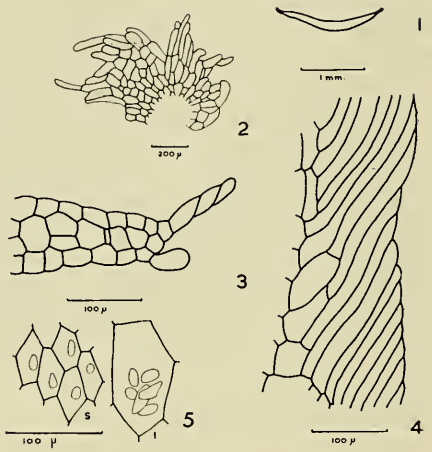
Typification: *Riccardia tenella*—Holotype—on soil by track through Moss Forest to Helicopter Pad, 2,450 m., Mt. Kaindi, Edie Creek, Morobe District, New Guinea, Hewson, 810, 9.1965, (NSW): Isotypes (LAE. L).

Specimens Examined: New Guinea: Pengage Creek, 2,750 m., Mt. Wilhelm, Hewson, 670, 672, (SYD. LAE. L); 2,450 m., Mt. Kaindi, Edie Creek, Hewson, 786, 815, 8.1965, (SYD. LAE. L).

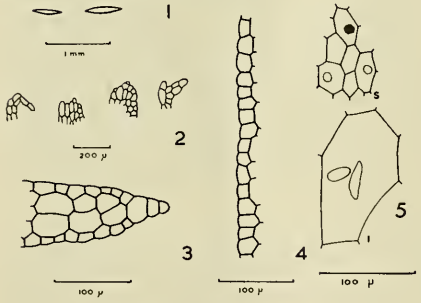
Distribution: New Guinea: 2,400–2,800 m.



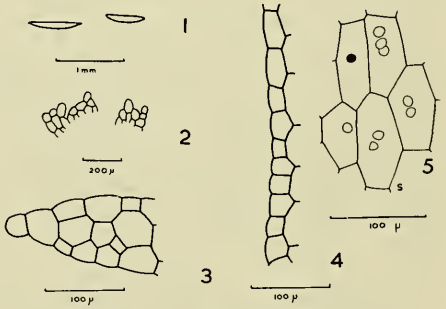
R. wattsiana



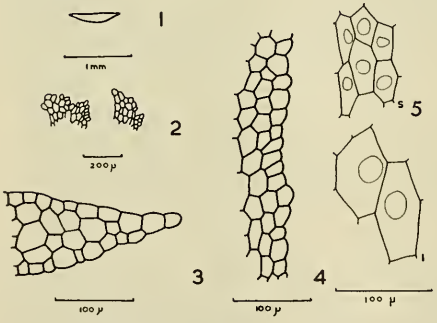
R argento-limbata



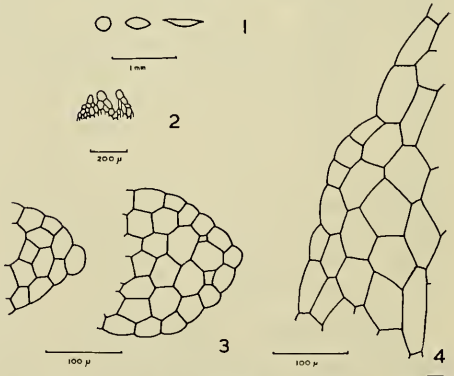
R. macdonaldiana



R. bipinnatifida



R. loriana



R. tenella

GP D

Fig. 9. 1. T. S. Thallus. 2. Paraphyses. 3. T. S. Thallus for margin anatomy. 4. Margin of thallus in surface view. 5. Oil bodies—S = in epidermal cells, I = in internal cells.

23. *Riccardia hypipamensis* Hewson, sp. nov.

Dioica. Thallus parvus, 0·5–1·0 (2·0) cm. longus, 0·5–1·0 mm. latus, plano-vel biconvexus, 5–8 cellulis crassitie, margine acuto; ramificatio bi- vel tripinnata; apices dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Corpora oleosa* 2–12 in quaque cellula, 3 × 3–7 × 7–3 × 8 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae (2) 3–4 cellula latitudine. *Rami plantarum femineorum* squamis pilisque multicellularibus archegonia cingentibus instructi. *Calyptra* 2–3 mm. longa, 5–7 cellulis crassitie; cellulis pachydermatici fasciculi dispersae et in umbone terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iv) similis. *Sporae* 12–16 (20) μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants on weathered basalt in rainforest. *Thalli* 0·5–1·0 (2·0) cm. long, 0·5–1·0 mm. wide with an acute but not winged margin, plano- to biconvex in transverse section, 5–8 cells thick; bi- to tripinnate branching; apex dissected and protected by ventral non-persistent mucilage papillae; rhizoids ventral; cuticle smooth. *Gemmae* not observed. *Oil bodies* 2–12 per cell, 3 × 3–7 × 7–3 × 8 μ. *Male plants* bearing antheridial branches lateral on main axis or pinnae, rarely terminal; antheridia in two rows up to 10 per row; dorso-lateral wing (2) 3–4 cells wide. *Female plants* bearing archegonial branches lateral on main axis or pinnae, archegonia in two rows usually presented lateral, protected by multicellular, fimbriate, scalelike paraphyses. *Calyptra* 2–3 mm. long at maturity, 5–7 cells thick; pachydermal cells in scattered clusters and a rough terminal cluster; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 12–16 (20) μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia hypipamensis* — Holotype — The Crater, Mt. Hypipamee, N. Qld., on weathering basalt in rainforest, Hewson, 448, 8.1964, (NSW): Isotype (SYD).

Specimens Examined: The Crater, Mt. Hypipamee, Hewson, 446, 447, 8.1964, (SYD. BRI).

Distribution: North Queensland: 900 m.

24. *Riccardia omkaliensis* Hewson, sp. nov.

Dioica. Thallus medius, 1–2 cm. longus, (0·5) 1–1·5 mm. latus, plano-vel concavo-convexus, 10–15 cellulis crassitie, margine acuto, ramificatio bi-vel tripinnata; apices dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Gemmae* prodiens. *Mycorrhiza* prodiens. *Corpora oleosa* (0) 1–2 (3) in quaque cellula, 8 × 10–12 × 15 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae (2) 3 (4) cellula latitudine. *Rami plantarum femineorum* squamis pilisque multicellularibus archegonia crassitie; cellulis pachydermatici in umbone terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iv) similis. *Sporae* 10–15 μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants prostrate on soil in disturbed regions. *Thalli* 1–2 cm. long (0·5) 1–5 mm. wide, with an acute winged margin, concave to plano-convex in transverse section; 10–15 cells thick; branching bi- to tripinnate; apex dissected, protected by ventral non-persistent mucilage papillae; rhizoids ventral; cuticle smooth. *Gemmae* produced. *Mycorrhiza* present in ventral internal cells. *Oil bodies* (0) 1–2 (3) per cell, 8 × 10–12 × 15 μ. *Male plants* bearing antheridial branches lateral on main axis and pinnae, sometimes reverting to vegetative growth; antheridia in two rows, up to 8 per row; dorso-lateral wing (2) 3 (4) cells wide. *Female plants* bearing archegonial

branches latero-ventral on main axis; archegonia in two rows; paraphyses multicellular, fimbriate, scalelike. *Calyptra* up to 4 mm. long at maturity, 9–12 cells thick; pachydermal armation apparently very variable, when immature smooth ± few small scattered pachydermal cells with smooth terminal umbo of pachydermals; after dehiscence calyptra is shaggy due to the breakdown of the internal cells and subsequent breaking of the epidermal layer; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia omkaliensis*—Holotype—Chimbu River, Gembogl, 2,150 m., Chimbu District, New Guinea, on soil of river bank exposed, Hewson, 575, 8.1965, (LAE): Isotypes (NSW. L).

Specimens Examined: Murigl River Valley, Omkali, Hewson, 547, 548, 550, 551, 552, 557, 558, 561, 7.1965, (SYD. LAE. L); Gembogl, Hewson, 566, 567, 568, 569, 570, 574, 8.1965, (SYD. LAE. L); Komamamambuno, Keglsugl, Hewson, 579, 580, 8.1965, (SYD. LAE. L); Marafunga, Hewson, 676, 677, 678, 679, 680, 681, 682, 686, 8.1965, (SYD. LAE. L); Tumbareri, Kagua, Hewson, 690, 8.1965, (SYD. LAE. L); Mungeri, Kagua, Hewson, 714, 718, 8.1965, (SYD. LAE. L); Edie Creek, Hewson, 827, 9.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,200–3,000 m.

25. *Riccardia womersleyana* Hewson, sp. nov.

Dioica. Thallus parvus, 0·5–1·5 cm. longus, 0·3–1·8 (1·0) mm. latus, ellipticus vel biconvexus (4) 7–10 (12) cellulis crassitie, margine obtuso (acuto); ramificatio bi- vel tripinnata; apices non dissecti; papillae mucilagineae laterales et ventrales, persistentes laterales. *Cuticula* laevis. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinatis; alae 1 cellula latitudine. *Rami plantarum feminearum* pilis et squamis pilisque multicellularibus archegonia cingentibus instructi. *Calyptra* 2–4 mm. longa, 5–8 cellulis crassitie; cellulis pachydermatici in fasciculi dentiformae dispersae. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 10–15 μ crassae.

Dioecious. Plants in loose mats on soil or rotten logs in rainforest. *Thallus* 0·5–1·5 cm. long, 0·3–0·8 (1·0) mm. wide, with an obtuse (acute) margin, elliptical to biconvex in transverse section, (4) 7–10 (12) cells thick; branching bi- to tripinnate with erect pinnules; apex not dissected, protected by lateral and ventral mucilage papillae which tend to persist laterally; rhizoids ventral; cuticle smooth. *Gemmae* produced in apical epidermal cells. *Oil bodies* unknown. *Male plants* bearing antheridial branches laterally on main axis and pinnae, recurved, not always of limited growth; antheridia in two rows, up to 12 per row; dorso-lateral wing one cell wide, cells elongate and overlapping as in incubous leaf orientation. *Female plants* bearing archegonial branches latero-ventrally on main axis; paraphyses multicellular, hairlike to fimbriate, scalelike. *Calyptra* 2–4 mm. long, 5–8 cells thick; pachydermal cells in scattered, multicellular, toothlike projections; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosomes* unknown.

Typification: *Riccardia womersleyana*—Holotype—Moss Forest, 2,450 m., Mt. Kaindi, Edie Creek, Morobe District, New Guinea, Hewson, 814, 9.1965, (NSW): Isotypes (L. LAE). Named in honour of Mr. J. S. Womersley who greatly assisted with my field trip to New Guinea.

Specimens Examined: Mt. Kaindi, Edie Creek, Hewson, 792, 813, 9.1965, (SYD. L. LAE).

Distribution: New Guinea: 2,400–2,500 m.

26. *Riccardia kowaldiana* (Stephani) Hewson comb. nov.

Nomenclatural Synonym: *Aneura kowaldiana* Steph., "Sp. Hep.," 1: 255 (1899).

Dioecious. Plants in dense cushions on soil or on logs in rainforest. *Thalli* (1) 2–3 (4) mm. long, 1–2 (2·5) mm. wide, with an acute winged margin, the cells of which have ± thickened walls, concave- to biconvex in transverse section, (7) 8–12 (20) cells thick; branching bi- to tripinnate; apex deeply dissected, protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced. *Mycorrhiza* present in ventral internal cells. *Oil bodies* unknown. *Male plants* bearing antheridial branches (often 2–3 together) laterally on pinnae and pinnules (rarely on main axis); antheridia in two rows, up to 12 per row; dorso-lateral wing crispate, ± dentate, 3–4 cells wide. *Female plants* bearing archegonial branches latero-ventral (often 2–3 together) on main axis; archegonia in two rows, protected by multicellular, fimbriate, scalelike and hairlike paraphyses. *Calyptra* up to 4 mm. long, 5–8 cells thick, pachydermal cells ± scattered and in a smooth terminal umbo; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–17 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Aneura kowaldiana* Steph.—Holotype—Mt. Yule, 2,140 m., New Guinea, Kowald, 123, 1895, (G 12060 ex Hb. Levier).

Specimens Examined: New Guinea: Pindaunde, 2,900 m., Mt. Wilhelm, Hewson, 588, 8.1965, (SYD. LAE. L); Lake Aunde, 3,500 m., Mt. Wilhelm, Hewson, 594, 598, 607, 632, 633, 8.1965, (SYD. LAE. L); Brass Tarn, 3,650 m., Mt. Wilhelm, Hewson, 659, 665, 8.1965, (SYD. LAE. L); Mungeri, Kagua, Hewson, 724, 8.1965, (SYD. LAE. L); Mt. Hagen Tea Plantation, Mt. Hagen, Hewson, 729, 8.1965, (SYD. LAE. L); Blue Nose Point, Edie Creek, Hewson, 767, 768, 769, 775, 779, 780, 8.1965, (SYD. LAE. L); Mt. Kaindi, 2,450 m., Edie Creek, Hewson, 790, 8.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,500 m.–3,700 m.

27. *Riccardia rupicola* (Stephani) Hewson, comb. nov.

Nomenclatural Synonym: *Aneura rupicola* Steph., "Sp. Hep.," 6: 41 (1917).

Misapplied Name: *Aneura palmata* (non (Hedw.), Dum.), Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 65 (1917).

Dioecious. Plants on soil and roots in damp places. *Thalli* 0·5–1·5 cm. long, 0·4–1·0 mm. wide, with acute margin, plano- to biconvex in transverse section, 4–8 cells thick; bi- to tripinnate branching, sometimes appearing palmate; apex dissected, protected by ventral non-persistent mucilage papillae; rhizoids rare; basal stolons present; cuticle smooth. *Gemmae* produced in the dorsal apical epidermal cells of some specimens. *Oil bodies* (0) 1 (2) per cell, 10 × 10–15 × 25 μ. Male plants bearing antheridial branches laterally on main axis and pinnae; antheridia in two rows, up to 7 per row; dorso-lateral wing 1 cell wide. *Female plants* bearing archegonia on latero-ventral cup-like branches; archegonia in two rows protected by multicellular, hairlike, fimbriate, scalelike paraphyses. *Calyptra* 2–4 mm. long at maturity, 5–8 cells thick; pachydermal cells scattered and in a loose terminal cluster; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 8–12 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Aneura rupicola* Steph.—Holotype—Shaw's Bay, East Ballina, NSW, Watts, 579, 9.1901, (G 11051 ex Hb. Levier 3388): Isotype (NSW 579).

Specimens Examined: Victoria: Beauglehole's property, Gorae West, Beauglehole, 1947, (MEL); NSW: Wardell Ferry, Richmond River, Watts, 177, 179, 10.1900, 473, 479, 6.1902, (SYD); Alstonville, Richmond River, Watts, 346, 10.1901, (SYD); East Ballina, Watts, 241, 3.1901, (SYD); Mt. Boyce, Blackheath, Hewson, 1, 2.1963, 166, 167, 168, 8.1963, (SYD); Neate's Glen, Blackheath, Hewson, 9, 2.1963, 66, 5.1963, 175, 8.1963, 316, 5.1964, (SYD); nr. Oakdale State Mine, Hewson, 35, 36, 4.1963, (SYD); Mermaid's Glen, Blackheath, Hewson, 82, 5.1963, (SYD); Oakland's Falls, Lawson, Hewson, 111, 5.1963, (SYD); Warrah, Pearl Beach, Hewson, 148, 149, 7.1963, 157, 8.1963, 338, 6.1964, (SYD); East Lindfield, Sydney [suburb], Hewson, 152, 154, 7.1963, (SYD); Fitzroy Falls, Hewson, 197, 8.1963, (SYD); Belmore Falls, Hewson, 198, 8.1963, (SYD); Cambewarra Mountain, Hewson, 205, 8.1963, (SYD); Bilpin, Hewson, 302, 4.1964, (SYD); Mt. Wilson, Hewson, 303, 330, 4.1964, (SYD); Grand Canyon, Blackhealth, Hewson, 320, 5.1964, (SYD); Queensland; Lake Eacham, Hewson, 393, 8.1964, (SYD, BRI); Tully Falls, Hewson, 405, 406, 8.1964, (SYD, BRI).

Distribution: Queensland, New South Wales, Victoria: sea level–1,000 m.

28. *Riccardia gracilis*

Riccardia gracilis (Steph.) Schuster in *J. Hatt. Bot. Lab.*, 26: 295 (1963).

Nomenclatural Synonym: *Aneura gracilis* Stephani, "Sp. Hep.," 1: 262 (1899); sed non Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 65 (1917).

Monoecious. *Plants* small. *Thalli* 0·5–1·0 cm. long, 0·4–0·8 mm. wide, with obtuse to acute margins, plano- to biconvex in transverse section, 5–7 cells thick; branching bi- to tripinnate; apex dissected, protected by ventral non-persistent mucilage papillae; dorsal epidermal cells equal in size to internal cells but the ventral cells smaller than the internal cells; rhizoids ventral; cuticle smooth. *Gemmae* in dorsal apical regions. *Oil bodies* unknown. *Male branches* short, lateral, produced before the female branches, often reverting to vegetative growth; antheridia in two rows, up to 6 per row; dorso-lateral wing one cell wide. *Female branches* reduced, latero-ventral; paraphyses multicellular, scalelike. *Calyptra* 2–4 mm. long; pachydermal cells thick walled arranged in clusters, more dense towards the apex, giving a rough shaggy appearance to calyptra. *Sporophyte* and *chromosomes* unknown.

Typification: *Aneura gracilis* Steph.—Holotype—Deep Creek, Mt. Wellington, Tasmania sine leg., sine no., 12.1897, (G 11043 ex Hb. Levier 973).

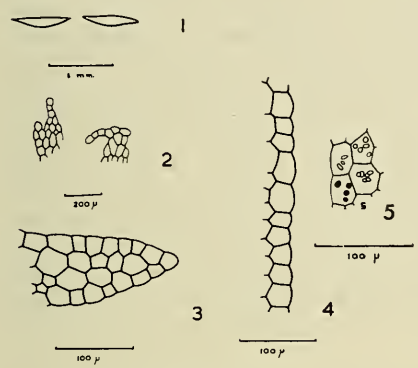
Discussion: This description has been made from a small voucher of one specimen. It is believed to be the holotype, but contrary to Stephani's type description, it is monoecious. Rodway, (1917), describes it as having a "ring of pilose hairs" on the apex of the calyptra. Schuster, (1963), proposes that the species may be closely allied to *Riccardia reducta* Schust., or to *Riccardia minima* Carr. et Pear. But it seems that the holotype, which has scattered clusters of pachydermal cells, does not bear these observations out. *Riccardia aequicellularis* (Steph.) Hews. has a crown of cilia-like pachydermal cells at the apex of the calyptra. This is what Rodway has described for *Riccardia gracilis* (Steph.) Schust., and *Riccardia reducta* Schust. appears to be a small form of *Riccardia aequicellularis* (Steph.) Hews. *Riccardia minima* Carr. et Pear. has a smooth compact terminal umbo of pachydermal cells only.

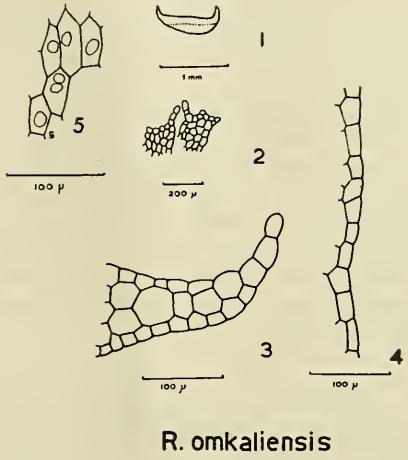
Distribution: Tasmania: 300–600 m.

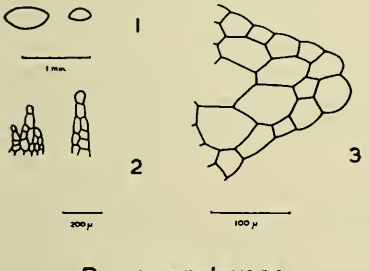
29. *Riccardia bongeriana** Hewson, sp. nov.

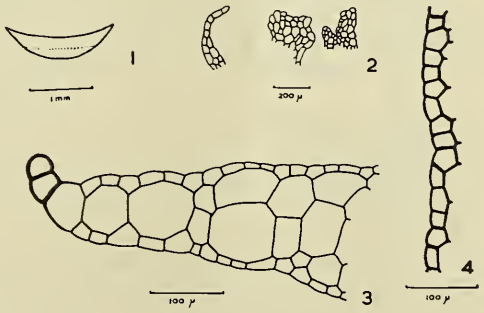
* This spelling of the specific epithet has been deliberately adopted.

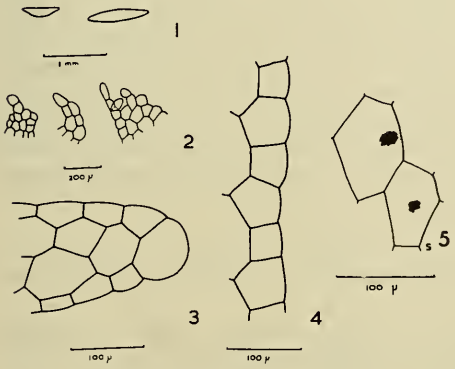
Dioica. Thallus parvus, 0·5–1·0 cm. longus, 0·2–1·0 mm. latus, plano- vel biconvexus, 4–8 cellulis crassitie, margine acuto, plus minusve alato; ramificatio bi- vel tripinnata; apices non dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Rami plantarum masculinarum*











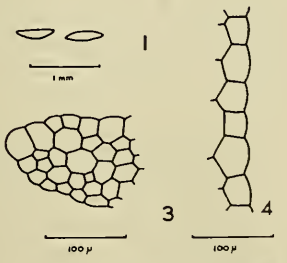


Fig. 10. 1. T. S. Thallus. 2. Paraphyses. 3. T. S. Thallus margin for anatomy. 4. Margin of thallus in surface view. 5. Oil bodies—S = in epidermal cells.

laterales; antheridia in seriebus 2 regularibus ordinatis; alae 1–2 cellula latitudine. *Rami plantarum feminearum* pilis et squamis multicellularibus archegonia cingentibus instructi. *Calyptra* 2–4 mm. longa 8–12 cellulis crassitie; cellulae pachydermaticae in fasciculi dispersi et in umbone aspero terminales. *Seta* 4 cellulis diametro. *Paries capsulae* eo *Riccardiae* (iii) similis. *Sporae* 12–16 μ crassae. *Chromosomata gametophytica* 10.

Dioecious. Plants on soil in running water in alpine grassland. *Thalli* 0·5–1·0 cm. long, 0·2–1·0 mm. wide, with an acute to winged margin, plano- to biconvex in transverse section, 4–8 cells thick; branching bi- to tripinnate; apex not dissected, protected by ventral non-persistent mucilage papillae; rhizoids ventral; cuticle smooth. *Gemmae* produced in dorsal and ventral apical epidermal cells. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on main axis, up to 3 together; antheridia in two rows, up to 8 per row; dorso-lateral wing 1–2 cells wide. *Female plants* bearing archegonial branches latero-ventral on main axis; archegonia in two rows, protected by multicellular, fimbriate, scalelike and hairlike paraphyses. *Calyptra* 2–4 mm. long, 8–12 cells thick; pachydermal cells in scattered multicellular clusters with or without a rough terminal umbo; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 12–16 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia bongeriana*—Holotype—4,100 m., in running water, Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 641, 8.1965, (NSW): Isotypes (LAE. L). Named in honour of Georg Bongery who was one of my guides on Mt. Wilhelm.

Distribution: New Guinea: 3,900–4,300 m.

30. *Riccardia gogolensis* (Stephani) Hewson, comb. nov.

Nomenclatural Synonym: *Aneura gogolensis* Steph., "Sp. Hep.," 1: 230 (1899).

Dioecious. Plants in loose mats creeping among other Bryophytes often including other *Riccardia* species, in rainforest. *Thalli* 1–2 cm. long, (0·5) 1·0–1·5 (2·0) mm. wide, margin with acute to winged, plano- to biconvex in transverse section, 5–9 cells thick; branching bi- to tripinnate; apex dissected, protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced in apical epidermal cells dorsal and ventral. *Oil bodies* unknown. *Male plants* bearing antheridial branches laterally on main axis and pinnae; antheridia in two rows, up to 20 per row; dorso-lateral wing (1) 2–3 (4) cells wide, tending to dentate. *Female plants* bearing archegonial branches latero-ventrally on main axis; paraphyses multicellular, hairlike to fimbriate, scalelike. *Calyptra* 1·5–3·0 mm. long, 4–8 cells thick, pachydermal cells in multi-cellular clusters and in a rough terminal umbo; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: ? n = 10.

Typification: *Aneura gogolensis* Steph.—Holotype—Gogol, New Guinea, Lauterbach, 988, (G 12057).

Specimens Examined: Philippines: Los Banos, Babin, 678, (G 12059); New Guinea: Gogol, Lauterbach, 1042, (G 12058); Bewapi Creek, nr. Lae, Hewson, 732, 734, 735, 736, 737, 739, 741, 8.1965, (NSW, LAE. L).

Distribution: New Guinea, Philippines: sea level–600 m.

31. *Riccardia colensoi*

Riccardia colensoi (Steph.) Martin in *Trans. Roy. Soc. New Zealand,* 78: 499 (1950).

Nomenclatural Synonym: *Aneura colensoi* Steph., Stephani in *J. Linn. Soc. Lond.*, 29: 264 (1892), et "Sp. Hep.," 1: 248 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.,* 1916: 63 (1917).

Taxonomic Synonym: *Aneura tasmanica* Steph., "Sp. Hep.," 1: 247 (1899); Rodway in *P. & Proc. of Roy. Soc. Tas.,* 1916: 64 (1917); sed non Stephani in *J. Proc. Roy. Soc. NSW,* 48: 97 (1914).

Dioecious. Plants in decumbent swards on soil or rock in damp wet places. *Thalli* (0·5) 1–3 (5) cm. long, (0·5) 1–2 (2·5) mm. wide, with obtuse to acute margin, plano- to biconvex in transverse section, 6–11 cells thick; branching bi- to tripinnate; apex deeply dissected, protected by ventral, non-persistent mucilage papillae; epidermal cells characteristically raised into papillae thickened at their apices, papilla height variable up to 70 μ, $\pm$ restricted to dorsal surface; rhizoids not observed; cuticle smooth. *Gemmae* not observed. *Oil bodies* fine globular composition 0–2 per cell, ovoid 5–10 μ in epidermal cells, irregular in shape, 10–15 × 15–25 μ in internal cells. *Male plants* bearing antheridial branches lateral on main axis and pinnae; antheridia in two rows, up to 6 per row; dorso-lateral wing 2–3 cells wide, projecting dorsally, with papillate marginal cells. *Female plants* bearing archegonial branches laterally on the main axes, tending to recurve but usually the archegonia presented dorsally; archegonia in two rows; protected by multicellular, hair-like to scalelike paraphyses with cells similar to epidermal cells. *Calyptra* 2–3 (4) mm. long at maturity, 5–10 cells thick; pachydermal cells solitary basal in clusters towards the apex, with a rough ill-defined terminal umbo, easily sloughed off; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall thickenings* of the *Riccardia*-type (iii). *Spores* 10–13 μ in diameter, minutely sculptured, scabrate. *Chromosomes* unknown.

Typification: *Aneura colensoi* Steph.—Holotype—New Zealand, Colenso, 1266, (G 11040 ex K). *Aneura tasmanica* Steph.—Holotype—Guy Fawkes River. nr. Hobart, Tasmania, Weymouth, sine no., 1.1898 (G 11055 ex Hb. Levier 968).

Specimens examined: Tasmania: Guy Fawkes River, sine leg., sine no., 9.1913, (HO 24, ex Hb. Rodway); 350 m., Mt. Wellington, sine leg., sine no., 8.1915, (HO 24 ex Hb. Rodway); Guy Fawkes River, Rodway, sine no., 1.1898, (HO 24, ex Hb. Rodway); Arve Bridge, Mt. Hartz National Park, Hewson, 227, 9.1963, (SYD); Silver Falls Track, Mt. Wellington, Hewson, 262, 9.1963, (SYD); Victoria: Upper Calder River, Otway Ranges, sine leg., sine no., (MEL 12W); Tarra Valley, Yarram, Healey, 78, 1961, (MEL 79 W); Black Spur, Bastow, sine no., 11.1900, (MEL 37); NSW: Mt. Boyce, Blackheath, Hewson, 164, 165, 8.1963, (SYD); Cambewarra Mountain, nr. Nowra, Hewson, 206, 207, 5.1963, (SYD); Happy Valley Creek, Mt. Wilson, Hewson, 308, 309, 5.1964, (SYD); Somersby Falls, Hewson, 844, 7.1966, (SYD).

Discussion: This species bears remarkable resemblance to *Riccardia crassa* in external morphology. Consequently it is impossible to distinguish them in the field. They are easily differentiated in the laboratory on epidermal cell form and cuticle type. Stephani (1914) records *Aneura tasmanica* Steph. as occurring at Horseshoe Falls, Blackheath, NSW, Watts, 1029, 1.1911, (NSW). This specimen is not *Riccardia colensoi* (Steph.) Martin. It is a very different species, having tripinnate branching, elliptical transverse section, 8–10 cells thick, central core of cells with thickened pigmented walls, and armed cuticle.

The specimen is sterile and I have been unable to find the type locality or to collect more material at other localities. If and when fertile gametophytes are found it will probably prove to be an undescribed species.

Distribution: New South Wales, Victoria, Tasmania, and New Zealand: 300–1,200 m.

32. *Riccardia crassa*

Riccardia crassa (Schwägr.) Carrington and Pearson in Proc. Linn. Soc. NSW, 12: 1056 (1888).

Nomenclatural Synonyms: *Jungermannia crassa* Schwägr. "Historiae Muscorum Hepaticarum Prodromus," 31 (1814); Weber, "Historiae Muscorum Hepaticarum Prodromus," 141 (1815). *Aneura crassa* (Schwägr.) Nees in Gottsche, Lindenberg et Nees. "Syn. Hep.," Hamburg, 500 (1846); Hook. f. "Handbook of the New Zealand Flora," 543 (1867); Carrington et Pearson in *P. & Proc. Roy. Soc. Tas.*, 1887: 52 (1888); Stephani, "Sp. Hep.," 1: 274 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 62 (1917). *Sarcomitrium crassum* (Schwägr.) Mitten in Hook. f., "Botany of the Antarctic Voyage, Flora New Zealandiae," 2, 2: 167 (1855); Mitten in Hook. f., "Botany of the Antarctic Voyage, Flora Tasmaniae," 3, 2: 239 (1860); Bastow in *P. & Proc. Roy. Soc. Tas.*, 1887: 277 (1888).

Taxonomic Synonyms: *Aneura coriacea* Steph., "Sp. Hep.," 6: 23 (1917). *Aneura longiflora* Steph., "Sp. Hep.," 1: 256 (1899) forma *submersa* Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 63 (1917). *Aneura pusilla* Steph. in *J. Proc. Roy. Soc. NSW*, 48: 96 (1914), et "Sp. Hep.," 6: 39 (1917). *Aneura rufescens* Steph. in *J. Proc. Roy. Soc. NSW*, 48: 96 (1914), et "Sp. Hep.," 6: 41 (1917). *Aneura spathuliloba* Steph., "Sp. Hep.," 6: 42 (1917). *Aneura stolonifera* Steph., in *Hedwigia*, 28: 129 (1889), et "Sp. Hep.," 1: 247 (1899); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 63 (1917). *Aneura striolata* Steph. in *J. Linn. Soc. Lon.*, 29: 265 (1892); synonomy proposed by Steph. in "Sp. Hep.," 1: 247 (1899). *Aneura walesiana* Steph. in *J. Proc. Roy. Soc. NSW*, 48: 97 (1914), et "Sp. Hep.," 6: 46 (1917).

Misapplied Name: *Aneura pinnatifida* (non Nees) Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 62 (1917).

Dioecious. Plants very variable in form and colour, common in South Eastern Australia, usually in dense mats or cushions on rock, soil, or wood in exposed to very wet conditions. *Thalli* (0·5) 1–3 (4·0) cm. long, (0·5) 1–2 (3) mm. wide, with obtuse to acute margins, plano- to biconvex in transverse section, (5) 6–10 (12) cells thick; branching pinnate to tripinnate (rarely quadripinnate); apex deeply dissected, protected by ventral non-persistent mucilage papillae; rhizoids not observed; basal stolons common; cuticle striate. *Gemmae* produced in some specimens in the apical growing regions. *Oil bodies* (0) 1–3 (4) per cell; 0–1 per cell and 5–15 × 8–20 μ in the epidermal cells; dimorphic, 1–3 round 12–20 × 15–30 μ, and 0–1 elongate, 5–12 × 40–150 μ in the internal cells. *Male plants* bearing antheridial branches laterally on the main axis or pinnae, up to 6 per row; dorso-lateral wing 1 cell wide. *Female plants* bearing archegonia on short branches laterally on main axis or pinnae (or stolons), 1–3 together, cup-shaped; archegonia in two rows, presented dorsally, protected by multicellular, hairlike, and scalelike paraphyses. *Calyptra* 3–5 mm. long, 4–7 cells thick; pachydermal cells scattered and in a loose terminal cluster; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (i). *Spores* 10–15 μ in diameter. minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Jungermannia crassa* (Schwägr.—Isotype—sine local., sine leg., sine no., (W ex Hb. Lindenberg 8045). *Aneura coriacea* Steph.—Holotype—Katoomba Falls, Watts 567, 1.1902, (G 11036 ex Hb Levier):

Isotype, (NSW). *Aneura pusilla* Steph.—Holotype—Old Railway Cutting, Blackheath, Watts, 1051, 1911, (G 11049 ex Hb. Watts): Isotype, (NSW). *Aneura rufescens* Steph.—Holotype—National Pass, Watts, 1124, 9.1912, (G 11050): Isotype, (NSW). *Aneura spathuliloba* Steph.—Holotype—Hermitage, Victoria, Goebel, sine no., (G 11052). *Aneura stolonifera* (Steph.—Holotype—Illawarra, Kirton, sine no., 1881, (G 11053 ex Hb. MEL). *Aneura striolata* Steph.—Holotype—Great Barrier Island, Colenso, 1111, (G 11054 ex Hb. K). *Aneura walesiana* Steph.—Holotype—Horse Shoe Falls, Watts, 1023, 1.1911, (G 11056 ex Hb. Watts): Isotype (NSW).

Specimens Examined: Western Australia: Sounness Park, Albany, Chessell, 460, 2.1964, (Hb. Uni. WA); Tasmania: The Acherson, Hooker, 1707, (Hb. Hodgson ex NY ex Hb. Mitten); Arthur's Lakes, Hooker, 1709, (Hb. Hodgson ex NY ex Hb. Mitten); Mt. Field W., sine leg., sine no., 2.1922, (HO 24 ex Hb. Rodway); Adventure Bay, sine leg., sine no., 3.1921, (HO 16 ex Hb. Rodway); 300 m., Mt. Wellington, sine leg., sine no., 1.1911, (HO 16 ex Hb. Rodway); 1050 m., Adamson Peak, sine leg., sine no., 12.1913, (HO 19 ex Hb. Rodway); nr. Lottah, Eastern District, Rodway, sine no., 8.1897, (HO 19 ex Hb. Rodway); 1,220 m., Mt. Wellington, Rodway, sine no., 1.1914, (HO 18 ex Hb. Rodway); 1,050 m., Mt. Field, sine leg., sine no., 12.1922, (HO 23 ex Hb. Rodway); Wellington Rivulet, sine leg., sine no., 10.1910, (HO 23 ex Hb. Rodway); 400 m., Mt. Wellington, sine leg., sine no., 8.1915, (HO 23 ex Hb. Rodway); Weldborough, Rodway, sine no., (HO 23 ex Hb. Rodway); 600 m., Blue Tier, East Coast, Weymouth, 1391, 12.1911, (HO 23 ex Hb. Weymouth); Adventure Bay, sine leg., sine no., 4.1911, (HO 23 ex Hb. Rodway); Fern Glade Falls, Mt. Wellington, Berrie, 124, 5.1963, (SYD); Pipe Line Track, Mt. Wellington, Berrie, 127, 5.1963, Hewson, 273, 277, 281, 284, 9.1963, (SYD); Huon River, Mt. Hartz National Park, Berrie, 128, 130, 133, 134, 135, 5.1963, Hewson, 208, 213, 216, 217, 223, 9.1963, (SYD); Arve Bridge, Mt. Hartz National Park, Hewson, 226, 228, 231, 232A, 9.1963, (SYD); Road to Esperance Lake, Mt. Hartz National Park, Hewson, 235, 9.1963, (SYD); Lake Dobson, Mt. Field National Park, Hewson 240, 241, 242, 244, 249, 250, 9.1963, (SYD); Russell Falls, Mt. Field National Park, Hewson, 252, 9.1963, (SYD); Fern Glade, Mt. Wellington, Hewson, 266, 9.1963, (SYD); Shoobridge Track, Mt. Wellington, Hewson, 269, 9.1963, (SYD); Organ Pipes Track, Mt. Wellington, Hewson, 271, 9.1963, (SYD); Victoria: Roaring Meg's Creek, Wilson's Promontory, Skewes, 10.1952, (MEL); Sealer's Cove, Gottsche, sine no., (MEL); Wilson's Promontory, Na Thalang, 852, 2.1967, (SYD); Korrumburra, Martin, sine no., 1891, (MEL); Cumberland Falls, Marysville, Kay, 3.1956, (MEL); NSW: Illawarra, Kirton, 1881 (MEL); Katoomba Falls, Watts, 564, 1.1902, (NSW); Neate's Glen, Watts, 689, 4.1903; 1017, 1.1911, (NSW); Lawson, Watts, 676, 4.1903, (NSW); Mittagong, sine leg., sine no., 170, 5.1917, (HO 20 ex Hb. Rodway); Woodford, Watts, 860, 3.1905, (NSW); Leura Glen, Watts, 695, 4.1903, (NSW); Wentworth Falls, sine leg., 330, 6.1889, (NSW); Gordon's Falls, Watts, 696, 4.1903, (NSW); Valley of Waters, Watts, 681, 4.1903, (NSW); Nadgee Fauna Reserve, Hewson, 530, 531, 4.1965, (SYD); Sugee Bag Creek, Hewson, 534, 5.1965, (SYD); Gwydir Highway, nr. Dandorah, Selkirk, 53, 5.1965, (SYD); Minnamurra Falls, Judd, sine no., 8.1956, (NSW); Mt. Boyce, Blackheath, Hewson, 2, 2.1963, (SYD); Neate's Glen, Blackheath, Hewson, 5, 6, 7, 8, 2.1963, 63, 64, 67, 68, 69, 71, 72, 74, 75, 77, 78, 79, 80, 5.1963, 177, 178, 8.1963, (SYD); Pacific Highway, past Waterfall Sanitarium, Hewson, 10, 11, 12, 3.1963, (SYD); Waterfall, Hewson, 13, 14, 15, 16, 18, 3.1963, (SYD); Adelina Falls, Lawson, Hewson, 20, 21, 22, 23, 24, 28, 29, 30, 31, 32, 33, 34, 3.1963, 117, 118, 119, 120, 122, 5.1963, 185, 186, 187, 189, 190, 8.1963, 293, 294, 295, 296, 297, 298, 2.1964, (SYD); nr. Oakdale State Mine, Hewson, 38, 39, 40, 41, 42, 43, 44, 46, 4.1963 (SYD); Mermaid's Glen, Blackheath, Hewson, 48, 49, 50, 52, 53, 54, 55, 56, 57, 59, 61, 5.1963,

81, 84, 85, 5.1963, 159, 160, 161, 8.1963, 522, 10.1964, (SYD); Centennial Glen, Blackheath, Hewson, 90, 91, 92, 94, 95, 96, 97, 5.1963, 170, 171, 8.1963, (SYD); Wentworth Falls, Hewson, 98, 101, 103, 105, 5.1963, (SYD); Valley of Waters, Wentworth Falls, Hewson, 106, 107, 108, 109, 5.1963 (SYD); Oaklands Falls, Lawson, Hewson, 110, 5.1963, (SYD); Junction Falls, Lawson, Hewson, 113, 116, 5.1963, (SYD); Warrah, Pearl Beach, Hewson, 140, 141, 142, 143, 144, 147, 7.1963, 156, 8.1963, (SYD); Minna Ha Ha Falls, Katoomba, Hewson, 179, 180, 8.1963, (SYD); Fitzroy Falls, Hewson, 191, 192, 193, 8.1963, (SYD); Belmore Falls, Kangaroo Valley, Hewson, 199, 200, 201, 8.1963, (SYD); Bilpin on Mt. Irvine Road, Hewson, 299, 300, 4.1964, (SYD); Grand Canyon, Blackheath, Hewson, 318, 5.1964, (SYD); Rodriguez Pass, Blackheath, Hewson, 323, 5.1964, (SYD); Happy Valley Creek, Mt. Wilson, Hewson, 328, 5.1964, (SYD); Somersby Falls, Hewson, 341, 342, 7.1964, 845, 846, 7.1966, (SYD); The Castle, Budawang Ranges, Hewson, 525, 526, 12.1964, (SYD).

Discussion: (i) *Aneura pinnatifida*—the specimens which Rodway has identified as *Aneura pinnatifida* Nees and which he used in the preparation of his descriptions are clearly not *Aneura pinnatifida* because they have striate cuticles. (ii) Environment—in the field there is a strong correlation between environment and size of plant. Those in drier exposed conditions are small, stunted and very coriaceous, and those in running water are large and robust but not coriaceous.

Distribution: New South Wales, Victoria, Tasmania and New Zealand: sea level–1,500 m.

33. *Riccardia aspera*

Riccardia aspera (Steph.) Grolle in *J. Hatt. Bot. Lab.*, 30: 117 (1967).

Nomenclatural Synonym: *Aneura aspera* Steph., "Sp. Hep.," 6: 21 (1917).

Dioecious. Plants in loose mats usually on rotting logs or humus soil in rainforest, and usually mixed with other Bryophytes, often including other *Riccardia* species. *Thalli* (0·5) 1–2 (3·5) cm. long, (0·5) 1–2 (2·5) mm. wide, (pinnules often less than 0·5 mm. wide) with an acute margin, plano- (ventral) to biconvex in transverse section, (4) 6–11 (13) cells thick; branching bi- to tripinnate, (quadripinnate); apex dissected and protected by ventral, non-persistent, mucilage papillae; rhizoids not observed, stolons frequently present; cuticle armed with dentate projections up to 12 μ high. *Gemmae* not observed. *Oil bodies* absent in epidermal cells (0) 1 (2) per cell in internal cells, (8) 10–20 (25) × (12) 20–25 (30) μ. *Male plants* bearing antheridial branches lateral on thallus; antheridia in two rows, up to 12 per row; dorsolateral wing (usually flattened), 1–2 (3) cells wide, irregularly dentate. *Female plants* bearing cup-shaped archegonial branches lateral on main axis; archegonia in two rows, protected by multicellular, dentate to fimbriate, hairlike and scalelike paraphyses. *Calyptra* up to 4 mm. long, 5–8 cells thick; pachydermal cells in scattered multicellular hairlike groups, up to 1 mm. long giving a very characteristic shaggy appearance; cuticle armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 9–14 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Aneura aspera* Steph.—Holotype—Tami Mundung, New Guinea, Schultze, 8, (G 12053 ex B).

Specimens Examined: New Guinea: Boridi, 1,650 m., Carr, 13578, 1935, (Hb. Grolle); Alola, 2,000 m., Carr, 15002/A,1936, (Hb. Grolle); Bivack, Bergman, Hl/a, 10.1949, (Hb. Grolle); Wakaru Range, Kagua, 1,850 m., Hewson, 693, 694, 702, 704, 708, 710, 712, 713, 8.1965, (SYD. LAE. L); Meri Creek, Edie Creek, 2,150 m., Hewson, 752, 8.1965, (SYD. LAE. L); Blue

Nose Point to Edie Creek, 1,850 m., Hewson, 773, 776, 8.1965, (SYD. LAE L); Mt. Kaindi, Edie Creek, 2,450 m., Hewson, 791, 792, 793, 794, 795, 798, 804, 805, 808, 811, 813, 814, 817, 8.1965, (SYD. LAE. L); to Bulldog Track, Edie Creek, 2,150 m., Hewson, 819, 820, 825, 830, 832, 9.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,500–2,500 m.

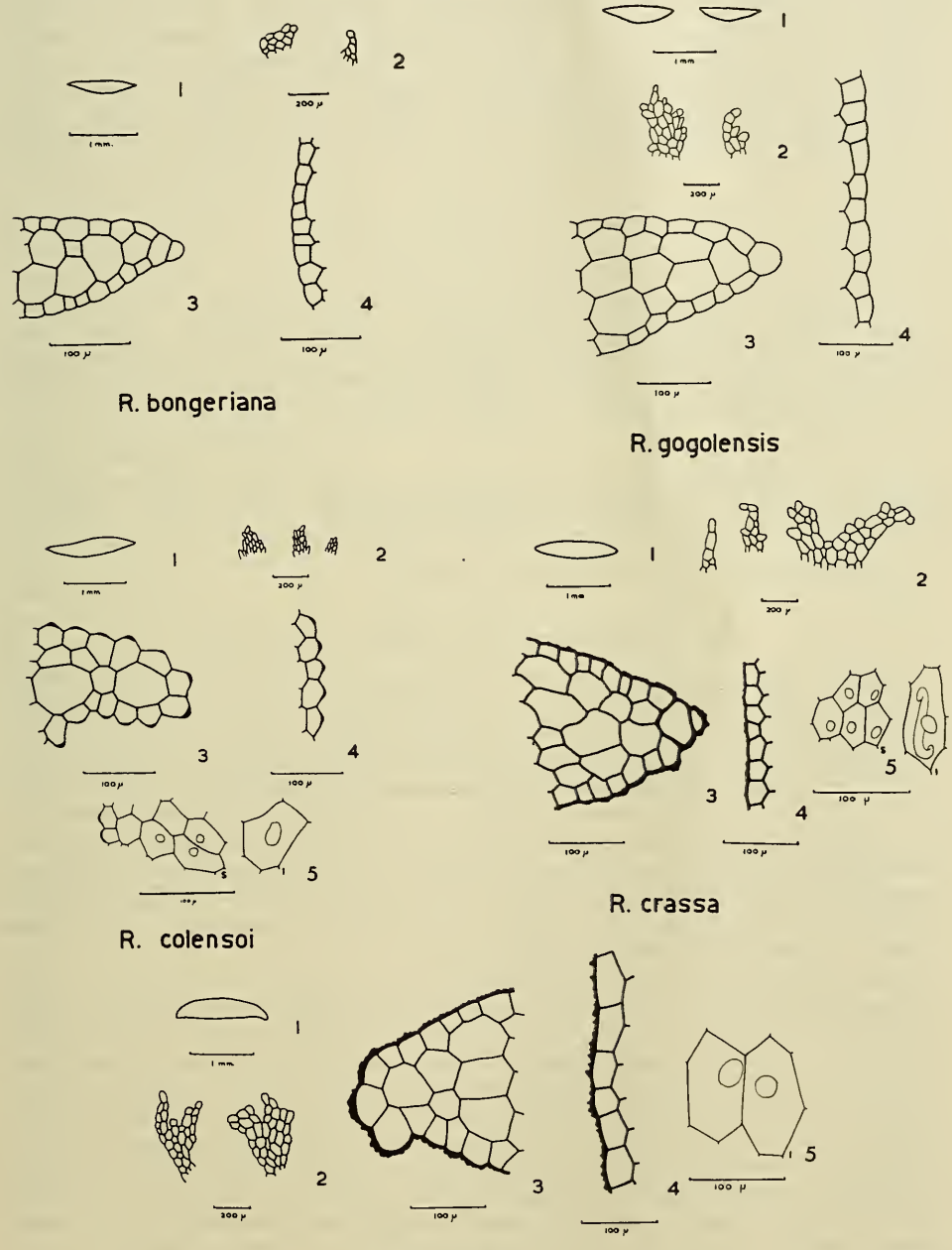


Fig. 11. 1. T. S. Thallus. 2. Paraphyses. 3. T. S. Thallus margin for anatomy. 4. Margin of thallus in surface view. 5. Oil bodies—S = in epidermal cells, I = in internal cells.

34. *Riccardia robinsii*

Riccardia robinsii Hewson et Grolle in *J. Hatt. Bot. Lab.*, 29: 72 (1966).

Dioecious. Plants in loose swards on soil in rainforest. *Thalli* large, differentiated into erect axes and lateral tri- to quadri-(multi-) pinnate branches. *Thallus axes* up to 12 cm. long, 1·0–2·0 mm. wide, with obtuse margins, elliptical in transverse section, 30–40 cells thick; cylinder of internal cells beneath epidermis 4–7 cells wide with thickened pigmented walls; epidermal cells tend to be produced as papillae especially ventrally (cf. *R. eriocaula*). *Thallus branches* 0·5–1·5 (2·0) cm. long, 0·3–0·5 mm. wide, with acute winged margin undulate, and recurved, with central nerve, reducing to 2 cells thick in ultimate pinnules; core of internal cells with thickened pigmented walls continuous with cylinder in axis. Branching quadri- to multipinnate with the first order regularly opposite; apex not dissected, protected by ventral mucilage papillae which tend to be non-persistent in the main axes and persistent in two rows in the branches; probable dormant apical regions present as depressions on the main axis; rhizoids not observed; cuticle smooth. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* unknown. *Female plants* bearing archegonial branches laterally and opposite on main axis adjacent to dormant apical regions; paraphyses multicellular, dentate to fimbriate scalelike. *Sporophyte* unknown. *Chromosomes* unknown.

Typification: *Riccardia robinsii* Hews. et Grol.—Isotype—montane forest, 3,200 m., Kubor Range, upper Minj Valley from Wahgi Valley, Western Highlands District, New Guinea, Robbins, 583, 1957, (JE, CANB), Holotype at B and Isotypes at CANB and NICH not seen by me.

Distribution: New Guinea: 3,000–4,000 m.

35. *Riccardia pengagensis* Hewson, sp. nov.

Dioica. Thallus grandis, 1–4 (7) cm. longus, (0·5) 1·0–1·5 (2·0) mm. latus; truncus ellipticus, 15–25 cellulis crassitie, margine obtuso vel acuto; ramus biconvexus, 10–15 cellulis crassitie, margine acuto (plus minusve alato); ramificatio tri- vel quadripinnata; apices non dissecti; papillae mucilagineae ventrales, non persistentes. *Cuticula* laevis. *Corpora oleosa* in quaque cellula 0–1 (2), 10 × 10–15 × 20 μ. *Rami plantarum masculinarum* laterales; antheridia in seriebus 2 regularibus ordinata; alae 3–5 (6) cellulis latitudine, undulatae. *Rami plantarum femineorum* squamis pilisque multicellularibus archegonia cingentibus instructi. *Calyptra* 3 mm. longa, 8–12 cellulis crassitie; cellulae pachydermaticae plus minusve dispersi et in umbone terminali. *Seta* 4 cellulis diametro. *Chromosomata gametophytica* 10.

Dioecious. Plants in dense cushions on rainforest floor or on rotten logs, upright, tending to have division into upright "stem" and lateral branches which tend to arise opposite each other. *Thalli* 1–4 (7) cm. long, (0·5) 1·0–1·5 (2·0) mm. wide, margin obtuse to acute, (± winged in branches), transverse section elliptical in main axis and biconvex in branches, main axis 15–25 cells thick and branches 10–15 cells thick, internal cells immediately beneath the dorsal epidermis tending to have thickened pigmented walls; branching tri- to quadripinnate; apex cleft and protected by ventral non-persistent mucilage papillae; rhizoids not observed; cuticle smooth. *Gemmae* not observed. *Oil bodies* 0–1 (2), absent in epidermis, 10 × 10–15 × 20 μ. *Male plants* bearing antheridial branches laterally on pinnae and pinnules; antheridia in two rows, up to 10 per row, dorso-lateral wing 3–5 (6) cells wide, wavy. *Female plants* bearing archegonial branches laterally on main axis and pinnae, archegonia in two rows; protected by multicellular, fimbriate, scalelike paraphyses. *Calyptra* 3 mm. long, 8–12 cells thick; pachydermal cells

± scattered and in smooth terminal umbo; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia pengagensis*—Holotype—Lake Aunde, 2,860 m., Mt. Wilhelm, Chimbu District, New Guinea, Hewson, 626, 8.1965, (NSW); Isotypes (LAE. L). Named after the Pengage Creek which drained the valley system including the Lakes Pinde and Aunde on Mt. Wilhelm.

Specimens Examined: New Guinea: Lake Aunde, 2,860 m., Mt. Wilhelm, Hewson, 597, 8.1965, (SYD. LAE. L); Wakaru Range, 1,850 m., Kagua, Hewson, 697, 8.1965, (SYD. LAE. L); Blue Nose Point, 1,830 m., Edie Creek, Hewson, 759, 8.1965, (SYD. LAE. L); 2,130 m., Edie Creek, Hewson, 834, (SYD. LAE. L).

Distribution: New Guinea: 2,100–2,900 m.

36. *Riccardia eriocaula*

Riccardia eriocaula (Hook.) Bescherelle et Massalongo in *Mission Sci. Cape Horn*, 5: 201 (1889); Schiffner in Engler and Prantl, "Nat. Pflanzenfamilien, 1, 3, 1: 53 (1893); Evans in *Trans. Conn. Acad. of Arts and Sci.*, 25: 122 (1921); Goebel, "Organography of Plants," 2: 26, 81 (1905), (as *R. eriocaulis*); Parihar, "An Introduction to Embryophyta": Bryophyta, 1: 82 (1956), (as *R. eriocaulis*).

Nomenclatural Synonyms: *Jungermannia eriocaula* Hooker, "Musci Exotici," 1: 72 (1818). *Metzgeria eriocaula* (Hook.) Nees in Gottsche, Lindenberg, and Nees, "Syn. Hep.," 505 (1846). *Sarcomitrium eriocaulum* (Hook.) Mitten in Hook. f., "Botany of the Antarctic Voyage, Flora Novae Zealandiae," 2, 2: 167 (1855); Mitten in Hook. f., "Botany of the Antarctic Voyage, Flora Tasmaniae," 3, 2: 239 (1860); Bastow in *P. & Proc. Roy. Soc. of Tas.*, 1887: 277 (1888). *Pseudoneura eriocaula* (Hook.) Gottsche, "De Mexikanske Levermosser," 259 (1867). *Aneura eriocaula* (Hook.) Hook. f., "Handbook of the New Zealand Flora," 543, (1867); Stephani in *Hedwigia*, 32: 137 (1893); Stephani, "Sp. Hep.," 1: 212 (1899); Cavers, "The Interrelationships of the Bryophyta," 66 (1911), reprinted from *The Phytologist*, 9, 10 (1910-11); Rodway in *P. & Proc. Roy. Soc. Tas.*, 1916: 61 (1917), reprinted "Tasmanian Bryophyta," 2: inset between 14 and 15 (1917).

Dioecious. *Plants* upright in dense swards on wood or humus soil, tend to be dendroid and have division of labour. *Thalli* with erect axes and lateral bipinnate branches. *Thallus axes* 1–3 (7) cm. long, 0·4–1·0 mm. wide, with obtuse margin, elliptical in transverse section, (8) 14–18 (20) cells thick: cylinder of cells 3–5 cells wide with thickened pigmented walls. *Thallus branches* up to 1 cm. long, less than 0·5 mm. wide with acute to winged margin, central nerve of core has internal cells with thickened pigmented walls continuous with cylinder in axis, biconvex in transverse section, 4–8 cells thick. Branching tripinnate with the first order regularly opposite; apex not dissected; surface armed with persistent elongate papillae, restricted to the region of the nerve on the branches, 30–130 μ long, 10–35 μ wide, arising around the apical cell and apparently are modified epidermal cells: mucilage papillae unconfirmed: rhizoids not observed; cuticle smooth. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral and opposite at bases of the pinnae and pinnules, recurved, laterally compressed; antheridia in two rows, up to 7 per row; dorso-lateral wing (3) 4–5 (6) cells wide, crispate, dentate. *Female plants* bearing archegonia in latero-ventral cups, arranged in pairs, opposite at the bases of the pinnae; archegonia presented dorsal, protected by multi-cellular, hairlike and fimbriate, scalelike paraphyses. *Calyptra* (2) 3 (4) mm. long at maturity, 4–6 cells

thick; pachydermal cells scattered tending to form multicellular projections towards the apex, and in a smooth terminal umbo; cuticle slightly armate. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 8–13 μ in diameter, minutely sculptured, scabrate. *Chromosomes* unknown.

Typification: *Jungermannia eriocaula* Hooker—Holotype—New Zealand, Mr. Menzies, sine no., (K). Hooker cites the holotype as "In sinu Dusky Bay dicto, apud Novam Zeelandiam, D. Menzies, 1791". Although this is more information than is cited on the Type packet from Kew, it would seem that this specimen is the holotype.

Specimens Examined: New Zealand: Colenso, 155, (K); Stephenson sine no., (NY ex Hb. Mitten); Westland, A.R.B., sine no., (NY ex Hb. Mitten); Pt. Preservation, Dr. Lyall, sine no., (K. NY ex Hb. Mitten); Port Nicholson. Dr. Lyall, 149, 1850, (K. NY ex Hb. Mitten); Otago, Hector, 19, 1864, (K. NY ex Hb. Mitten); Colenso, 808, (NY ex Hb. Mitten); Knight, sine no., (NY ex Hb. Mitten); Greymouth, Helms, sine no., 1877, (NY ex Hb. Columbia College); Chau-iti River, Tararua Mountains, Zotov, 10.1933, (NY); Tasmania: Gordon River, Weymouth, 1448, 1.1914, (NY); Frenchman's Cap, Moore 13, (MEL); Rodway, sine no., (HO 32); Arve Bridge, Mt. Hartz National Park, Hewson, 232B, 9.1963, (SYD).

Discussion: This species and those closely related to it (*R. robinsii* Hews. et Grol., *R. pengagensis* Hews., *R. australis* (Lehm.) Hews., *R. demkarmana* Hews., *R. anguste-alata* (Steph.) Hews., *R. fuegiensis* Massal., *R. prehensilis* (Hook. f. et Tayl.) Massal., *R. savatieri* (Steph.) Evans, *R. thaxteri* Evans, *R. elata* (Steph.) Schiffn., and *R. tjibodensis* Schiffn.), exhibit the highest degree of differentiation observed in the genus *Riccardia*. They have internal cells which are thickened and which consequently allow them to have a division of labour within the thallus into an upright supporting axis and lateral photosynthesising branches. In spite of this obvious relationship, the only other consistent character held by these species is the tendency for the branches to arise opposite each other. See the mixed data analysis section.

Distribution: Tasmania, New Zealand.

37. *Riccardia australis* (Lehm.) Hewson, comb. nov.

Nomenclatural Synonyms: *Sarcomitrium australe* Lehmann in "Novarum et Minus Cognitarum Stirpium," Pugillus, 10: 19 (1857). *Aneura australis* (Lehm.) Steph., "Sp. Hep.," 1: 274 (1899).

Dioecious. Plants tending to have differentiation into erect axis and lateral photosynthesising branches. *Thalli* 1–5 cm. long, 0·5–1·5 mm. wide, (ultimate branches often less than 0·5 mm. wide), with obtuse to acute (especially in lateral branches) margins, elliptical to biconvex, (7) 9–15 (18) cells thick in main axis and (4) 5–8 (12) cells thick in lateral branches; branching tripinnate with first order arising opposite from the main axis of growth; apices not dissected though slightly cleft, mucilage papillae ventral, non-persistent; rhizoids not observed; cuticle smooth. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* bearing antheridial branches lateral on thalli, often 2–3 together, usually arising as third order of branching; antheridia in two rows up to 8 per row; dorso-lateral wing (1) 2–3 (4) cells wide, $\pm$ dentate, $\pm$ recurved. *Female plants* bearing archegonial branches latero-ventral, cup-shaped, opposite in axes of lateral branches on main axis; paraphyses multicellular, scalelike. *Calyptra* up to 5 mm. long; pachydermal cells scattered and in a rough terminal umbo. *Seta* of the *Riccardia*-type. *Capsule wall thickenings* of the *Riccardia*-type (iii). *Spores* 10–12 (15) μ in diameter, minutely sculptured, scabrate. *Chromosomes* unknown.

Typification: Holotype—*Metzgeria australis* Lehmann, n. sp., sine loc., Dr. Preiss, sine no., (S-PA ex Hb. Lehmann).

Specimens Examined: New Zealand: Colenso, sine no., 12.1885, (K); Colenso, 4124, (K); Colenso, 4681, (K); Colenso, 5157, (K); *Sarcomitrium australe* Lehm., sine loc., sine leg., sine no., (K ex Hb. Mus. Paris, 40).

Distribution: Western Australia, New Zealand. Preiss is known only as an Australian collector. Since Lehmann cites Swan River as the locality for *R. australis,* it seems reasonable to conclude that the holotype was collected in Western Australia. Thus it is surprising that no material of this species has been found in the intermediate geographic regions of Victoria and Tasmania.

38. *Riccardia demkarmana* Hewson, sp. nov.

Dioica. Thallus parvus, 1–3 cm. longus, 0·5–1·0 mm. latus; truncus ellipticus, 8–20 cellulis crassitie, margine obtuso; ramus biconvexus nervosus, 3–5 cellulis crassitie, margine acuto, alato undulato; ramificatio tri- vel quadripinnata; apices non dissecti; papillae mucilagineae ventrales, in seriebus 2 persistentes. *Cuticula* laevis. *Gemmae* apicales. *Corpora oleosa* in quaque cellula 0–12, 2 × 3–3 × 15 μ. *Rami plantarum masculinarum* laterales recurvati, antheridia in seriebus 2 regularibus ordinata; alae 3–5 cellulis latitudine, undulate. *Rami plantarum feminearum* oppositi pilis et squamis multicellularibus archegonia cingentibus instructi. *Chromosomata gametophytica* 10.

Dioecious. Plants on rotting logs in rainforest, upright, tending to have division into upright "stem" and lateral branches which tend to arise opposite each other. *Thalli* 1–3 cm. long, 0·5–1·0 mm. wide; main axis elliptical in transverse section, 8–20 cells thick, margin obtuse; branches recurved, undulate, winged with a central nerve, 3–5 cells thick, margin acute, winged; branching tri- to quadri-pinnate; apex not dissected, protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* produced in apical epidermal cells (at least of the branches). *Oil bodies* 0–12 per cell, 0–9 in wing cells, up to 12 in main branch cells, 2 × 3–3 × 15 μ. *Male plants* bearing antheridial branches laterally, tending to be recurved; antheridia up to 6 per row; dorso-lateral wing 3–5 cells wide, undulate. *Female plants* bearing archegonial branches latero-ventrally, the branches opposite on main axis; paraphyses multicellular, scalelike and hairlike. *Calyptra* with few scattered pachydermal cells and a smooth terminal umbo; cuticle smooth. *Seta* of the *Riccardia*-type. *Capsule wall anatomy* of the *Riccardia*-type (iv). *Spores* 10–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10.

Typification: *Riccardia demkarmana* — Holotype — Pengage Valley, 2,730 m., Mt. Wilhelm, Chimbu District, New Guinea, on rotten log in rainforest. Hewson, 667, 8.1965, (LAE): Isotypes (NSW, L). Named in honour of Demkarma Bonipas who was my chief guide on Mt. Wilhelm, and reputed to own the valley of Mt. Wilhelm in which I worked.

Specimens Examined: New Guinea: Komamamambuno, 2,580 m., Mt. Wilhelm, Hewson, 582, 8.1965, (SYD, LAE, L); Mt. Kaindi, 2,420 m., Hewson, 807, 809, 814, 8.1965, (SYD, LAE, L); Edie Creek, 2,130 m., Hewson, 820, 8.1965, (SYD, LAE, L).

Distribution: New Guinea: 2,100–2,800 m.

39. *Riccardia anguste-alata* (Stephani) Hewson comb. nov.

Nomenclatural Synonyms: *Aneura angust-alata* Steph., "Sp. Hep.," 6: 20 (1917). *Aneura angustiala*—Nomen nudem, Bonner, "Index Hepaticarum," 2: 87 (1962), (as Nomen Herbariorum, see discussion).

Taxonomic Synonyms: *Aneura fruticosa* Steph., "Sp. Hep.," 6: 27 (1917).

Dioecious, rarely monoecious. *Plants* in loose cushions on rotten logs or humus soil in rainforest. *Thalli* tend to be differentiated into an upright "stem" and lateral branches, 1–5 cm. long, 0·5–1 (1·5) mm. wide, with acute, winged margins (especially in branches), plano- to biconvex in transverse section; 3–15 cells thick; branching tri- to quadripinnate (multipinnate), first order of branching tends to arise in opposite sequence; apex cleft to dissected, protected by ventral mucilage papillae which tend to persist in two rows; rhizoids ventral; cuticle smooth. *Gemmae* not observed. *Oil bodies* unknown. *Male plants* bearing antheridial branches laterally on main axis, pinnae and pinnules, ± recurved; antheridia in two rows, up to 12 per row; dorso-lateral wing 2–5 cells wide ± dentate, projecting laterally. *Female plants* bearing archegonial branches latero-ventrally, ± opposite on main axis and pinnae; paraphyses large multi-cellular hairs and fimbriate scales. *Calyptra* 2·5–4·5 mm. long, 6–10 cells thick; pachydermal cells in scattered long multicellular clusters giving capsule a very shaggy appearance; cuticle slightly armate. *Seta* 4 cells in diameter. *Capsule wall anatomy* of the *Riccardia*-type (iii). *Spores* 8–15 μ in diameter, minutely sculptured, scabrate. *Chromosome number*: n = 10 in dioecious specimens, unknown in monoecious specimens.

Typification: *Aneura anguste-alata* Steph.—Lectotype—*Aneura angustiala*, Sattelberg, New Guinea, Nyman, (G 12208); Isotype—Sattelberg, Kaiser Wilhelms Land, Nyman, (UPS).

Here I am proposing that *A. angustiala* material is in fact *A. anguste-alata*. A specimen collected by Nyman at Sattelberg in New Guinea was given the name *angustiala* by Stephani, but no description has been published. The original specimen is at Geneva and a duplicate of it is at Uppsala. However Stephani has published another name for a Nyman specimen. This is *A. anguste-alata*. But there is no packet of *A. anguste-alata* in Geneva or Uppsala, and I have been unable to locate one elsewhere. I am unable to find any reasonable significant difference between the specimen labelled *A. angustiala* and the type description of *A. anguste-alata*, hence I propose that the *A. angustiala* material is in fact *A. anguste-alata*, and that the change in spelling in publication was not attended to on the packets. *Aneura fruticosa* Steph.—Holotype—Tami, *Nova Guinea*, Schultze, 7, (G 12056 ex B).

Specimens Examined: New Guinea: Meri Creek, Edie Creek, Hewson, 751, 8.1965, (SYD. LAE. L); Blue Nose Point, Edie Creek, Hewson, 754, 756, 762, 776, 8.1965, (SYD. LAE. L); Mt. Kaindi, Edie Creek, Hewson, 797, 798, 801, 802, 803, 817, 9.1965, (SYD. LAE. L).

Distribution: New Guinea: 1,500–2,450 m.

Summary to Key

Species listed in sequence as in paper and key.

Australia		*New Guinea*	
36. *R. crinacaula*	28. *R. gracilis*	34. *R. robinsii*	3. *R. pindaundensis*
37. *R. australis*	8. *R. bliklika*	38. *R. demkarmana*	4. *R. ibana*
16. *R. cochleata*	10. *R. minima*	39. *R. anguste-alata*	22. *R. tenella*
15. *R. longiflora*	17. *R. wattsiana*	35. *R. pengagensis*	25. *R. womersleyana*
31. *R. colensoi*	23. *R. hypipamensis*	33. *R. aspera*	12. *R. umbana*
32. *R. crassa*	27. *R. rupicola*	18. *R. argento-limbata*	13. *R. tumbareriensis*
2. *R. alcicornis*	19. *R. macdonaldiana*	14. *R. pindensis*	11. *R. babindae*
5. *R. aequicellularis*	20. *R. bipinnatifida*	13. *R. tumbareriensis*	9. *R. bliklika*
11. *R. babindae*		26. *R. kowaldiana*	7. *R. agumana*
		14. *R. pindensis*	6. *R. phleganiana*
		24. *R. omkaliensis*	17. *R. wattsiana*
		26. *R. kowaldiana*	22. *R. tenella*
		17. *R. wattsiana*	6. *R. phleganiana*
		30. *R. gogolensis*	29. *R. bongeriana*
		21. *R. loriana*	21. *R. loriana*
		1. *R. geniana*	

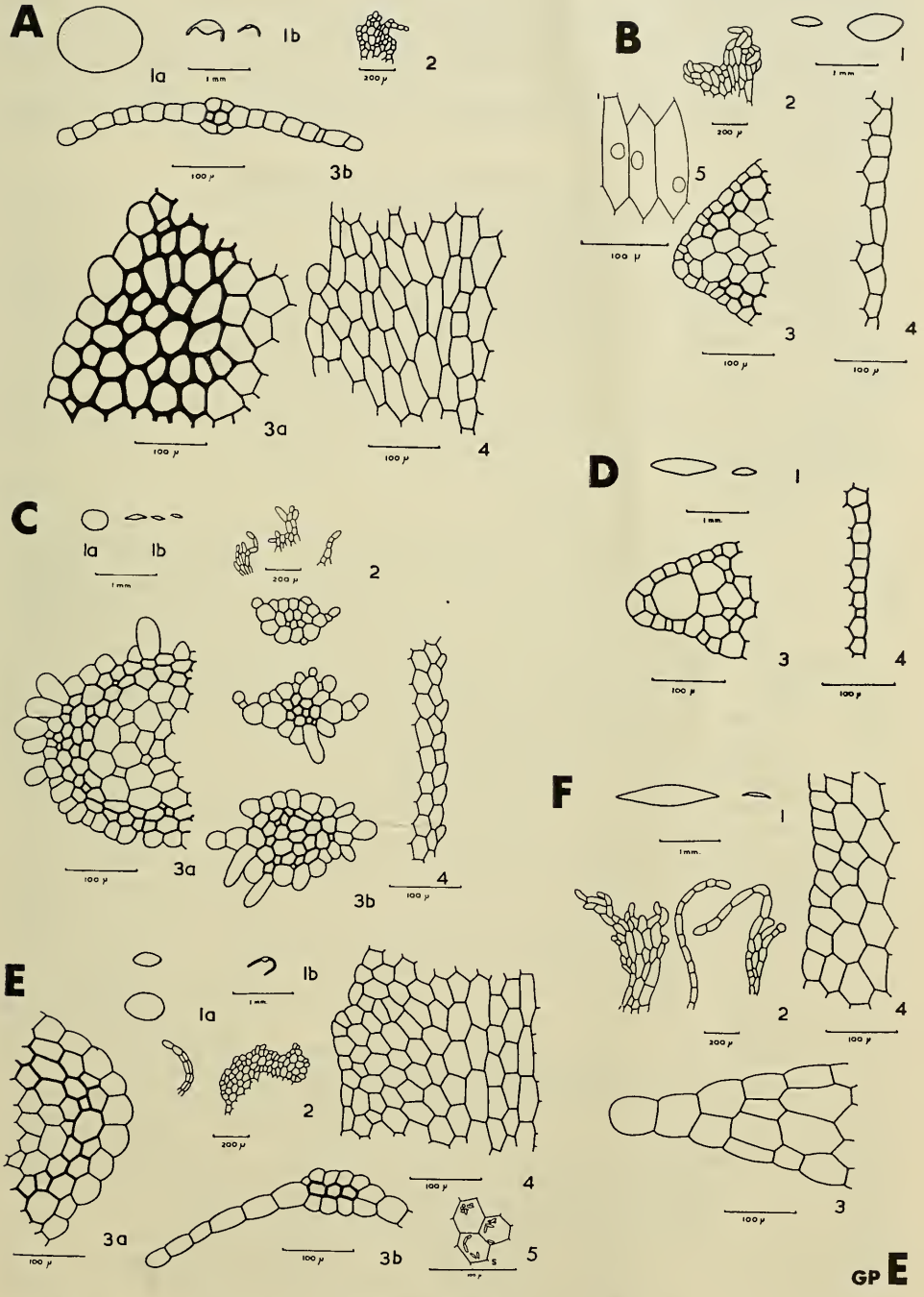


Fig. 12. A. *R. robinsii*. B. *R. pengagensis*. C. *R. eriocaula*. D. *R. australis*. E. *R. demkarmana*. F. *R. anguste-alata*. 1. T. S. Thallus—(*a*) main axis, (*b*) branches. 2. Paraphyses. 3. T. S. Thallus for anatomy—(*a*) main axis, (*b*) branches. 4. Margin of branches in surface view. 5. Oil bodies—S = in epidermal cells.

Cell Wall Anatomy Types

Riccardia-type (i)—Bands of thickening on the adaxial radial walls and inner tangential walls of both the outer and inner cell layer.

Riccardia-type (ii)—Bands of thickening on the adaxial radial walls and inner tangential walls of both the outer and inner cell layer (nodulose in the outer layer).

Riccardia-type (iii)—Bands of thickening on the adaxial radial walls and inner tangential walls of the outer cell layer, and ill defined bands on the adaxial radial walls of the inner cell layer.

Riccardia-type (iv)—Bands of thickening on the adaxial radial walls and inner tangential walls of the outer cell layer and no bands on the walls of the inner cell layer.

Key to the Australian Species of Riccardia

1. Thalli differentiated into erect axes with lateral branches which arise in opposite sequences. Axes robust (7)–14–(20) cells thick, margins obtuse; branches (4)–8–(12) cells thick with acute to winged margins....2
   2. Epidermal cells raised into elongate persistent papillae. Mucilage papillae indistinguishable. Lateral branches with central nerve and wings...*R. eriocaula*
   2* Epidermal cells not raised into papillae. Ventral non-persistent mucilage papillae present. Lateral branches without central nerve, margin acute (winged)....*R. australis*

1* Thalli not differentiated into erect axes and lateral branches. Axes (3)–7–(12) cells thick with various margins; branches similar to main axis....3
   3. Thallus axis mean width more than 1·0 mm. Cuticle armed, or epidermal cells tending to be papillate, or marginal cell walls tending to be thickened. Apices deeply dissected....4
      4. Thalli plano- to deeply concave-convex in transverse section. Cuticle smooth. Marginal cell walls thickened....5
         5. Thalli (1·0)–2·0–(4·0) mm. wide; branching pinnate (bipinnate). Calyptra 2–4 mm. long; pachydermal cells in multicellular pigmented clusters....*R. cochleata*
         5* Thalli (1·0)–1·5–(2·0) mm. wide; branching pinnate to tripinnate. Calyptra up to 8 mm. long, pachydermal cells scattered and in rough terminal cluster....*R. longiflora*
      4* Thalli biconvex to plano-convex in transverse section. Cuticle striate or thickened at apex of each epidermal cell. Marginal cell walls not thickened....6
         6. Epidermal cells raised into papillae with cuticle thickened at apex; cuticle smooth. Male branch dorso-lateral wing 2–3 cells wide. Pachydermal cells in loose multicellular clusters and in rough terminal umbo. Capsule wall thickenings of the *Riccardia*-type (iii)....*R. colensoi*
         6* Epidermal cells not raised into papillae. Cuticle armed with striations. Male branch dorso-lateral wing 1 cell wide. Pachydermal cells scattered and in rough terminal umbo. Capsule wall thickenings of the *Riccardia*-type (i)....*R. crassa*
   3* Thallus axis mean width less than 1·0 mm. Cuticle smooth, epidermal cells never papillate, and marginal cell walls not thickened. Apices may be dissected but not deeply....7
      7. Thallus axis mean width less than 0·5 mm., maximum width less than 1·0 mm. Apices not dissected (except in *R. gracilis*)....8
         8. Thallus axes 8–12 cells thick; elliptical in transverse section; obtuse (acute) margins; internal cells usually with thickened pigmented walls. Spores with papillate projections....*R. alcicornis*
         8* Thallus axes 2–7 (8) cells thick; (elliptical in *R. aequicellularis*) biconvex to plano-convex in transverse section; obtuse to winged margins; internal cell walls not thickened and pigmented. Spores scabrate....9
            9. Mucilage papillae around the apical cell. Pachydermal umbo a crown of cilia-like cells. Capsule wall thickenings of the *Riccardia*-type (ii)....*R. aequicellularis*
            9* Mucilage papillae lateral and/or ventral to apical cell, never dorsal. Pachydermal armation various, never in a crown of cilia-like cells. Capsule wall thickenings of the *Riccardia*-type (iii) or (iv)....10
               10. Mucilage papillae lateral (never ventral), branched...*R. babindae*
               10* Mucilage papillae ± lateral and ventral, club shaped....11
                  11. Thallus apices dissected, margins never winged; 5–7 cells thick. Pachydermal cells in multicellular clusters, and rough terminal umbo....*R. gracilis*
                  11* Thallus apices not dissected, margins winged, 3–5 (6) cells thick. Pachydermal cells absent or scattered, umbo rough or neat....12

12. Wing 3–5 cells wide. Mucilage papillae ventral non-persistent. Female branches arise irregularly. Pachydermal cells scattered and in rough terminal umbo.... ....*R. bliklika* var. *bliklika*

12* Wing 1–3 cells wide. Mucilage papillae lateral and ventral, persistent. Female branches arise opposite. Pachydermal cells in neat terminal umbo.....*R. minima*

7* Thallus axis mean width more than 0·5 mm., maximum width more than 1·0 mm. Apices dissected (except *R. macdonaldiana*).....13

13. Oil bodies 1–15 per cell. Male branch dorso-lateral wing (1) 3–4 cells wide. Either monoecious or with pachydermal cells in multicellular clusters 14

14. Monoecious. Thallus winged, 3–6 cells thick. Pachydermal cells scattered and terminal umbo rough.....*R. wattsiana*

14* Dioecious. Thallus acute, not winged, 5–8 cells thick. Pachydermal cells in multicellular clusters and rough terminal umbo..... .....*R. hypipamensis*

13* Oil bodies 0–4 per cell. Male branch dorso-lateral wing (0) 1–(2) cells wide. Dioecious. Pachydermal cells not in multicellular clusters....15

15. Branching often appearing palmate. Mucilage papillae non-persistent. Female branches latero-ventral.....*R. rupicola*

15* Branching never palmate. Mucilage papillae tend to be persistent. Female branches lateral.....16

16. Thalli usually less than 1·0 mm. wide. Apex not dissected. Male branches bear up to 25 antheridia per row..... .....*R. macdonaldiana*

16* Thalli usually more than 1·0 mm. wide. Apices dissected. Male branches bear up to 7 antheridia per row....*R. bipinnatifida*

Key to the New Guinea Species of Riccardia

1. Thalli differentiated into erect axes with lateral branches which arise in opposite sequences. Axes robust (8) 15–30 (40) cells thick with obtuse to acute margins; branches 2–15 cells thick with acute to winged margins.....2

2. Thallus axes round to elliptical (8) 15–30 (40) cells thick, margins obtuse. Thallus branches with central nerve and broad wing more than 5 cells wide 3

3. Thallus axes massive, up to 12 cm. long, 1–2 mm. wide, 30–40 cells thick.... .....*R. robinsii*

3* Thallus axes up to 3 cm. long, 0·5–1·0 mm. wide, 8–20 cells thick..*R. demkarmana*

2* Thallus axes elliptical to biconvex 8–25 cells thick, margins obtuse to winged. Thallus branches without narrow central nerve, wing less than 5 cells wide (if present).....4

4. Thallus axes plano- to biconvex, winged in transverse section. Mucilage papillae persistent. Paraphyses 0·8–1·2 mm. long. Pachydermal cells elongate multicellular clusters.....*R. anguste-alata*

4* Thallus axes elliptical to obtuse in transverse section. Mucilage papillae non-persistent. Paraphyses 0·2–0·6 mm. long. Pachydermal cells ± scattered and in neat terminal umbo.....*R. pengagensis*

1* Thalli not differentiated into erect axes and lateral branches. Axes 3–12 (20) cells thick with various margins; branches similar to main axis.....5

5. Mean width more than 1·0 mm. Maximum width more than 1·0 mm.....6

6. Marginal cells with thickened walls, or characteristically elongate, or cuticle armed with striations.....7

7. Cuticle armed with striations.....*R. aspera*

7* Cuticle smooth.....8

8. Marginal cells elongate. No mycorrhiza.....*R. argento-limbata*

8* Marginal cell walls thickened. Mycorrhiza present.....9

9. Thalli up to 8 cells thick. Mucilage and mucilage papillae conspicuous. Apical region broad. Capsule wall anatomy of *Riccardia*-type (i). Spores with papillate projections.....*R. pindensis*

9* Thalli (7) 8–15 cells thick. Mucilage and mucilage papillae not conspicuous. Apical region narrow. Capsule wall anatomy not *Riccardia*-type (i). Spores scabrate.....10

10. Thalli deeply concave-convex in transverse section. Male branch dorso-lateral wing 1–2 cells wide. Pachydermal cells in multicellular clusters.....*R. tumbarerensis*

10* Thalli biconvex to concave-convex in transverse section. Male branch dorso-lateral wing 3–4 cells wide. Pachydermal cells ± scattered and in neat umbo .....*R. kowaldiana*

6* Marginal cells not markedly different from other epidermal cells. Cuticle smooth 11

11. Mycorrhiza present....12
12. Thalli up to 8 cells thick. Mucilage and mucilage papillae conspicuous. Apical region broad. Capsule wall anatomy of *Riccardia*-type (i). Spores papillate....*R. pindensis*
12* Thalli (7) 8–15 (20) cells thick. Mucilage and mucilage papillae not conspicuous. Apical region narrow. Capsule wall anatomy not *Riccardia*-type (i). Spores scabrate....13
13. Apices dissected, protected by ventral non-persistent mucilage papillae. Calyptra massive, 9–12 cells thick....*R. omkaliensis*
13* Apices deeply dissected and protected by ventral persistent mucilage papillae. Calyptra 5–8 cells thick....*R. kowaldiana*
11* Mycorrhiza absent....14
14. Monoecious....*R. wattsiana*
14* Dioecious....15
15. Mucilage papillae persistent. Male branches with up to 20 antheridia per row. Paraphyses 0·3–0·5 mm. long. Pachydermal cells in multicellular clusters with rough terminal umbo....*R. gogolensis*
15* Mucilage papillae non-persistent. Male branches with up to 10 antheridia per row. Paraphyses 0·1–0·3 mm. long. Pachydermal cells ± scattered and in neat terminal umbo....*R. loriana*

5* Mean width less than 1·0 mm. Maximum width less than 1·0 mm....16
16. Circular to biconvex in transverse section, with obtuse to acute margins....17
17. Mean width less than 0·4 mm. Maximum width 0·5 (0·8 in *R. geniana*)....18
18. Mucilage papillae absent. Pachydermal cells scattered and in neat terminal umbo. Calyptra wall 8–13 cells thick....*R. geniana*
18* Mucilage papillae present. Pachydermal cells scattered, and in rough terminal umbo. Calyptra wall 4–8 cells thick....19
19. Cuticle armed with fine striations. Spores papillate....*R. pindaundensis*
19* Cuticle smooth. Spores scabrate....*R. ibana*
17* Mean width more than 0·4 mm. Maximum width 1·0 mm....20
20. Male branch dorso-lateral wing 1–3 cells wide. Paraphyses 0·1–0·2 mm. long. Pachydermal cells ± scattered and in rough terminal umbo....*R. tenella*
20* Male branch dorso-lateral wing 1 cell wide. Paraphyses 0·2–0·4 mm. long. Pachydermal cells in multicellular clusters and in rough terminal umbo....*R. womersleyana*
16* Biconvex to concave-convex in transverse section, with acute to winged margins....21
21. Apices deeply dissected; concave-convex in transverse section. Thalli 7–13 cells thick. Mycorrhiza present....22
22. Male branches dorso-lateral wing 3–4 cells wide. Pachydermal cells in elongate multicellular clusters. Spores papillate, 15–20 μ in diameter....*R. umbana*
22* Male branch dorso-lateral wing 1–2 cells wide. Pachydermal cells in multicellular clusters. Spores scabrate, 10–15 μ in diameter....*R. tumbarerienssis*
21* Apices if dissected not deeply dissected, not concave-convex in transverse section. Thalli 3–7 (8 in *R. bongeriana*) cells thick. Mycorrhiza absent....23
23. Thalli 3–4 cells thick, up to 0·6 (0·8 in *R. agumana*) mm. wide....24
24. Mucilage papillae lateral only, and branched....*R. babindae*
24* Mucilage papillae ventral, and club shaped....25
25. Monoecious. Apices not dissected....*R. bliklika*

25* Dioecious. Apices dissected..26
26. Male branch dorsolateral wing 1–2 cells wide. Pachydermal cells in multicellular clusters and rough terminal umbo..*R. agumana*
26* Male branch dorsolateral wing 2–3 (4) cells wide. Pachydermal cells scattered and in rough terminal umbo .....*R. phleganiana*
23* Thalli (3) 4–9 cells thick, up to 1·0 (2·0 in *R. wattsiana*) mm. wide.....27
27. Monoecious.....*R. wattsiana*
27* Dioecious 28
28. Capsule wall 4–7 cells thick..29
29. Thalli 5–9 cells thick. Paraphyses 0·1–0·2 mm. long. Thallus variable in transverse section — circular to nerved with wide wing...*R. tenella*
29* Thalli 3–5 cells thick. Paraphyses 0·2–0·4 mm. long. Thallus plano- to biconvex in transverse section. Wing narrow.....*R. phleganiana*
28* Capsule wall 7–12 cells thick.....30
30. Male branch dorso-lateral wing 1–2 cells wide. Pachydermal cells in multicellular clusters, and ± rough umbo.....*R. bongeriana*
30* Male branch dorso-lateral wing 2–4 cells wide. Pachydermal cells in ± scattered and neat umbo..*R. loriana*

Doubtful Species

1. *Nomina nuda*

Aneura alato-pinnata—Nomen Herbariorum—Bonner, Index Hepaticarum, 2 (1962).

In 1893, Loria collected a specimen, No. 843, at 1,300 m. on Mt. Moroka in the Moresby District in New Guinea. In 1899 Stephani apparently intended to describe this as *Aneura alato-pinnata*—Stephani, 843, ex. Hb. Jack, 1900, in G12207. However, Beccari collected a specimen in Borneo which originally went to Bescherelle's Herbarium. In 1893 Stephani described this as *Aneura nobilis,* but not before De Notaris gave it the Nomen Herbariorum *Aneura pinnataeformis.* This specimen is in Geneva as No. 12211. Before *Aneura alato-pinnata* was to be published, Stephani apparently decided that the material should have been identified as *Aneura nobilis* Steph., and wrote this on his own duplicate specimen of No. 843, now in Geneva as No. 12212. Consequently one would expect that *Aneura nobilis* Steph. has a New Guinea distribution. However, G 12207 is not the same as G 12212, possibly resulting from a number change on G 12212 from 472 to 834. The specimen G 12212 is *Riccardia loriana* (Steph.) H. A. Mill., and the specimen G 12207 is *Riccardia kowaldiana* (Steph.) Hews. Hence the name *Aneura alato-pinnata* remains a Nomen Herbariorum, and the species *Aneura nobilis* Steph. is not yet known to have a New Guinea distribution. *Aneura angustifolia*—Nomen Herbariorum—Bonner, "Index Hepaticarum," 2 (1962). *Aneura angustiala*—Nomen Herbariorum—Bonner, "Index Hepaticarum," 2 (1962). See *Riccardia anguste-alata* (Steph.) Hews. *Aneura grossereticulata*—Nomen Herbariorum—Bonner, "Index Hepaticarum," 2 (1962).

2. *Nomina dubia*

The Ledermann Hepatic Collections from New Guinea have been destroyed in Berlin. So far I have been unable to locate any duplicate material of

these collections. His collections included seven holotypes of the Genus *Riccardia* described by Stephani sub *Aneura*. They are: *Aneura augustae* Steph., "Sp. Hep.," 6: 430 (1923). *Aneura hunsteinii* Steph., "Sp. Hep.," 6: 431 (1923). *Aneura latemultifida* Steph., "Sp. Hep.," 6: 431 (1923). *Aneura ledermanii* Steph., "Sp. Hep.," 6: 431 (1923). *Aneura rotangicola* Steph., "Sp. Hep.," 6: 432 (1923). *Aneura subledermannii* Steph., "Sp. Hep.," 6: 432 (1923). *Aneura subteuerrima* Steph., "Sp. Hep.," 6: 432 (1923). Unfortunately the type descriptions are inadequate to characterize these species. Rather than erect neo-types with the risk of inaccuracy, these are being treated as nomina dubia. Some of the newly described species may later be proven to be taxonomic synonyms.

3. *Rejected Reports*

(i) Misapplied names are recorded in the text with the species to which they have been misapplied.

(ii) *Aneura graeffei* Steph., in *Hedwigia*, 32: 21 (1893). This is a Fijian species and the Lauterbach specimen (G 12210) from New Guinea is not *Riccardia graeffei* (Steph.) Hews. comb. nov. It is close to *Riccardia loriana* (Steph.) H. A. Mill. and may be a misapplied name for this species.

(iii) *Riccardia multispica* (Steph.) Hatt. sub *Aneura multispica* Steph., in "Sp. Hep.," 6: 34 (1917). This described from an Hawaiian collection but cited by Stephani as "Hab. Hawaii, Nova Guinea, Nova Caledonia, Japonia. (Valde communis, Faurie Legit)". However, Faurie 94, from Hawaii is not close to any species found in New Guinea. It has also been rejected as occurring in Japan, (Mizutani et Hattori, 1957).

(iv) *Riccardia ridleyi* Schiffner, in *Kais. Ak. Wien*, 67: 172 (1898).

References

Arnell, S., 1962.—Hepaticae collected by Dr. O. H. Selling in Central Australia, Tasmania and New Zealand in 1949, *Bot. Not.* 115: 311–317.

Bastow, R. A., 1888.—Tasmanian Hepaticae. *P. & Proc. Roy. Soc. Tasmania.* 1887: 209–289.

————, 1914.—Victorian Hepaticae. *Victorian Nat.* 31 (5): 74–81.

Bescherelle, E. and C. Massalongo, 1889.—Hepatiques, in Muscinees. *Mission Sci. Cap. Horn*, 1882–1883. 5: 201–252.

Bonner, C. E. B., 1962.—"Index Hepaticarum." Vol. 2. Weinheim.

Carrington, B., 1870.—Dr. Gray's arrangement of the Hepaticae. *Trans. & Proc. Bot. Soc. Edinburgh.* 10: 305–309.

Carrington, B. and W. H. Pearson, 1888.—List of Hepaticae collected by R. A. Bastow near Hobart, Tasmania. *P. & Proc. Roy. Soc. Tasmania.* 1887: 49–52.

————, ————, 1888.—List of Hepaticae collected by Mr. Thomas Whitelegge in New South Wales. 1884–85. J. Linn. Soc. New South Wales. 11 (4): 1035–1060.

Carrutiiers, W., 1865.—On the nomenclature of the British Hepaticae. *Seem. London J. Bot.* 3: 297–302.

Cavers, F., 1911.—"The Inter-relationships of the Bryophyta." *New Phytologist* Reprint, No. 4. Cambridge, (*New Phytologist.* 9, 10: 1910, 1911)).

Colenso, W., 1885.—A description of some newly discovered and rare indigenous plants; being a further contribution towards the making known the Botany of New Zealand. *Trans. & Proc. N.Z. Inst.* 1884. 17: 237–269.

————, 1886.—A description of some newly discovered Cryptogamic plants; being a further contribution towards the making known the Botany of New Zealand. *Trans. & Proc. N.Z. Inst.* 1885. 18: 219–255.

————, 1890.—A description of some newly discovered indigenous Cryptogamic plants. *Trans & Proc. N.Z. Inst.* 1889. 22: 425–458.

Corda, A. K. J., 1828–29.—Genera Hepaticarum: Die Gattungen der Lebermoose, in "Opiz, Beiträge zur Naturgeschichte" 12: 643–655. Reprint in *Ann. Bryol.* 10: 9–15 (1937).

————, 1835.—Deutschlands Jungermannien in J. Sturm, Deutschlands Flora, 2 5/6): 116–121, Berlin.

Dumortier, B. C., 1822.— "*Commentationes Botanicae.*" Tournay.

————, 1831.—"Sylloge Jungermannidearum Europae indigenarum." Tournay.

————, 1835.—"Recueil d'observations sur les Jungermanniacees." Tournay.

———, 1874.—Hepaticae Europae, Jungermannideae Europae post semisseculum recensitae, adjunctis Hepaticis. *Bull. Soc. R. Bot. Belgique.* 13: 1–203.
Evans, A. W., 1893.—An arrangement of the genera of Hepaticae. *Trans. Conn. Acad. Arts Sci.* 8 (2): 262–280.
———, 1921.—The genus *Riccardia* in Chile. *Trans. Conn. Acad. Arts Sci.* 25: 93–209.
———, 1938.—The structure of the capsule wall in certain species of *Riccardia*. *Ann. Bryol.* 10 (1937): 20–35.
———, 1939.—The classification of the Hepaticae. *Bot. Rev.* 5: 49–96.
Goebel, K., 1905.—"Organography of Plants." Vol. 2. Transl. by Bayley-Balfour. Oxford.
Gottsche, K. M., 1856.—Plantae Mullerianae: Hepaticae Australasiae a Dr. F. V. Müller. Linnaea. *Beitr. zur Pflanz.* 28: 547.
———, 1867.—De Mexikanske Levermosser. *Dansk. Vid. Selsk. Skrift.* 5, 6: 97–381.
———, J. B. W. Lindenberg, and C. G. Nees ab Esenbeck, 1844–47.—"Synopsis Herpaticarum." Hamburg.
Gower, J. C., 1966.—Some distinctive properties of latent root and vector methods used in multi variate analysis. *Biometrika* 53: 325–338.
Gray, S. F., 1821.—"A natural arrangement of British plants." Vol. 1. London.
Grolle, R., 1960.—Bryological Notes: Zur Nomenklatur von *Riccardia pinguis*. *Trans. Brit. Bryol. Soc.* 3 (5): 746–747.
———, 1966.—Lebermoose aus Neuguinea. 2. *J. Hatt. Bot. Lab.* 29: 70–74.
———, 1967.—Lebermoose aus Neuguinea. 6. *J. Hatt. Bot. Lab.* 30: 113–118.
Harley, J. L., 1959.—"The biology of mycorrhizae." London.
Hewson, M. J., 1970.—The Family Aneuraceae in Australia and New Guinea: I The Genus *Aneura*. Proc. Linn. Soc. N.S.W., 94 (2): 173–193.
Hodgson, E. A., 1965.—New Zealand Hepaticae (Liverworts)—16. A miscellany of new genera, new species and notes, part 1. *Trans. Roy. Soc. N.Z. Bot.* 3 (4): 67–97.
Hooker, J. D., 1867.—Handbook of the New Zealand Flora. 2, Hepaticae, 497–549. London.
———, and T. Taylor, 1844.—Hepaticae Antarcticae, *Lond. J. Bot.* 3: 366–400.
———, ———, 1845.—Hepaticae Antarcticae, Supplementum. *Lond. J. Bot.* 4: 79–97.
Hooker, W. J., 1818.—"Musci Exotici; containing figures and descriptions of new or little known foreign Mosses and other Cryptogamic subjects." Vol. 1. London.
Hübener, J. W. P., 1834.—"Hepaticologia Germanica, oder Beschreibung der Deutschen Lebermoose." Mannheim.
Kremp, G. O. W., 1965.—"Morphologic Encyclopedia of Palynology." Tucson.
Kuntze, O., 1891.—"Revisio Genera Plantarum." Leipzig.
Lance, G. N. and W. T. Williams, 1967.—Mixed-Data Classificatory Programs. I. Agglomerative Systems. *Aust. Computer J.* 1 (1): 15–20.
———, P. W. Milne and W. T. Williams, 1968.—Mixed-Data Classificatory Programs. III. Diagnostic Systems. *Aust. Computer J.* 1 (3): 178–181.
Lehmann, J. G. C., 1857.—"Novarum et Minus Cognitarium Stirpium." Pugillus 10: Addita ennumeratione plantarum omnium in Pug. 1–10. descriptarum. Hamburg.
Lindberg, S. O., 1877.—Monographia Metzgeriae. *Acta. Soc. F. et Fl. Fennica.* 1 (2): 3–48.
Linnaeus, C., 1753.—"Species Plantarum." Vol. 2. Holmiae.
Martin, W., 1950.—The Bryophytes of Stewart Island. II. *Trans. Roy. Soc. N.Z.* 78: 485–501.
Meijer, W., 1959.—Notes on species of *Riccardia* from their type localities in Western Java. *J. Hatt. Bot. Lab.* 21: 61–78.
Miller, H. A., 1963.—Notes on Hawaiian Hepaticae. *V. Ark. f. Bot.* 5 (2): 489–531.
Mitten, W., 1851.—Catalogue of Cryptogamic plants collected by W. Jameson in the vicinity of Quito. *Hooker's Lond. J. Bot.* 3: 351–361.
———, 1855.—In J. D. Hooker, "Botany of the Antarctic Voyage. Flora Nova Zelandiae." Vol. 2, Pt. 2. London.
———, 1860.—In J. D. Hooker, "Botany of the Antarctic Voyage. Flora Tasmaniae." Vol. 3, Pt. 2. London.
Mizutani, M. and S. Hattori, 1957.—An etude on the systematics of Japanese *Riccardias*. *J. Hatt. Bot. Lab.* 18: 27–64.
Müller, K., 1951–58.—Die Lebermoose Europas, in L. Rabenhorst. "Kryptogamen-Flora." 3rd Edition. 6: 1–1365.
Nees ab Esenbeck, C. G., 1838.—"Naturgeschichte der Europäischen Lebermoose." 3: 1–594.
Palisot, de Beauvois, A. M. F. J. B., 1804.—"Flore d'Oware et de Benin en Afrique." Paris.
Parihar, N. S., 1956.—'An introduction to Embryophyta." Bryophyta. I. 4th Edition. Allahabad.
Raddi, G., 1818.—"Jungermanniografia Etrusca." Modena. Reprinted in *Mem. Soc. Ital. Sci. Modena.* 18: (1820).
Rodway, L., 1917.—"Tasmanian Bryophyta." Vol. 2. Hobart. Reprinted from *P. & Proc. Roy. Soc. Tasmania.* 1916: 1–92 (1917).
Schiffner, V., 1890.—Lebermoose mit Zugrundelegung der von Dr. A. C. M. Gottsche ausgeführten Vorarbeiten. Forschungsreise S. M. S. "Gazelle", *Bot.* 4 (4): 1–48.

———, 1893.—Hepaticae, in E. Engler and K. Prantl, "Die Naturlichen Pflanzenfamilien." 1 (3): 1-141. Leipzig.
———, 1898.—Exposita plantarum in itinere Suo Indico annis 1893–94 suscepto collectarum. I. *Denkschr. Acad. Wiss. Wien.* 67: 153–203.
Schuster, R. M., 1958.—Keys to the Orders, Families and Genera of Hepaticae of America and North of Mexico. *The Bryologist* 61: 1–66.
———, 1963.—Studies on Antipodal Hepaticae, 1. Annotated keys to the genera of Antipodal Hepaticae with special reference to New Zealand and Tasmania. *J. Hatt. Bot. Lab.* 26: 185–309.
———, 1964.—Studies on Antipodal Hepaticae, 4. Metzgeriales. *J. Hatt. Bot. Lab.* 27: 183–216.
Schwägrichen, C. F., 1814.— "Historiae Muscorum Hepaticarum." Prodromus. Leipzig.
Stephani, F., 1889.—Hepaticae Australiae. *Hedwigia.* 28: 128–35, 155–75, 257–78.
———, 1892.—A revision of Colenso's Hepaticae with descriptions of new Species collected by him. *J. Linn. Soc. London.* 29: 263–280.
———, 1893.—Hepaticarum species novae, 1–4. *Hedwigia.* 32: 17–29, 137–47, 204–15, 315–27.
———, 1896.—Hepaticae, in F. Reinecke, Die Flora der Samoa-Inseln. *Engler's Bot. Jahrb.* 23: 300–316.
———, 1898–1899.—"Species Hepaticarum." Vol. 1. Geneva.
———, 1917–1924.—"Species Herpaticarum." Vol. 6. Geneva.
———, and W. W. Watts. 1914.—Hepaticae Australes. *J. Proc. Roy. Soc. New South Wales.* 48: 94–135.
Swartz, O., 1806.— "Musci Hepatici. Flora Indiae Occidentalis." Vol. 3. Erlangae.
Taylor, T., 1844.—Hepaticae, in J. D. Hooker, "The Botany of the Antarctic Voyage. Flora Antarctica: Botany of Lord Auckland's Group and Campbell's Island." Vol. 1. Pt. 1. London.
———, 1847.—Hepaticae, in J. D. Hooker, "The Botany of the Antarctic Voyage. Flora Antarctica: Botany of Fuegia. The Falkland's and Kerguelen's Lands." Vol. 1. Pt. 2. London.
Trevisan de Saint Leon, V., 1874.—Nuovo censo delle Epatiche Italiana. *R. Ist. Lombardo di Sci. e Lett Milano.* 2 (7): 776–786.
———, 1877.—Schema di Una Nuova Classificazione delle Epatiche. *R. Ist. Lombardo di Sci. e Lett. Milano.* 3 (4): 383–451.
Verdoorn, F., 1834.—Bryologie und Hepaticologie, ihre Methodik und Zukunft. *Ann. Bryol.* 4: 1–39.
Weber, F., 1815.—"Historiae Muscorum Hepaticarum Prodromus." Kiel.